PREDICTION OF OCCLUSAL DENTINE RADIOLUCENCIES ON BITEWING RADIOGRAPHS BY CLINICAL EXAMINATION OF UNSEALED AND SEALED PERMANENT MOLAR TEETH

Matthew S. Fracaro BDS

THE UNIVERSITY OF QUEENSLAND
School of Dentistry

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Department / School Dentistry

Research Supervisor: Associate Professor W. Kim Seow

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Associate Professor W. K Seow

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I, Matthew Steven Fracaro of 225 Swann Road, Brisbane, do solemnly and sincerely declare that these Research Project Reports have been composed by myself and have not been accepted in part or in full for another degree. I make this declaration conscientiously believing that the same to be true, before a Justice of the Peace.

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PREFACE

Over the past decade there has been a growing concern regarding the diagnosis of occlusal caries in children and adolescents in light of the increasing contribution of occlusal caries to the overall caries experience in this age group. Previous studies abroad in adolescents and young adults have confirmed what clinicians have observed for a number of years, and that is that a clinically sound permanent molar can present with an occlusal dentine radiolucency on a bitewing radiograph. These occlusal dentine lesions have anecdotally been referred to as "fluoride bombs", reflecting the consensus opinion that fluoride, through its effects on the remineralization and demineralization cycles of caries progression, provided the explanation for why a dentine radiolucency could exist beneath a clinically intact occlusal surface. Studies thus far fail to provide an accurate estimation of the magnitude of the problem of so-called hidden or occult caries, owing to both non-standardized and inappropriate clinical criteria, and to biases in the retrospective collection of data. This research project was therefore undertaken to determine both the extent and nature of these lesions in a child population in Brisbane, Australia, using objective, prospective assessments of both clinical and radiographic appearance of lesions. Scientific paper I reviews current clinical methods of occlusal caries diagnosis, and is presented here in the format for the Australian Dental Journal in which publication is intended. Scientific paper II documents the research report, formatted for submission to the Pediatric Dentistry Journal.

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CLINICAL DIAGNOSIS OF OCCLUSAL CARIES:

A LITERATURE REVIEW

Matthew S. Fracaro BDS,

W. Kim Seow BDS, MDSc, PhD, DDSc, FRACDS,

Laurence B. Walsh, BDSc, PhD, DDSc, FFOP (RCPA), FICD, GCEd

Abstract

Occlusal caries diagnosis has become increasingly more difficult due to a preponderance of early lesions over and above the more clinically obvious, cavitated forms. This shift has highlighted the fact that our understanding of caries pathogenesis has outstripped our diagnostic technologies, and has compelled the profession forward in search of newer, more accurate and reliable caries detection methods. Alongside traditional methods of occlusal caries diagnosis based largely on visual–tactile examination, are those which have emerged relatively recently and are arousing particular interest amongst clinicians and researchers alike. This review focuses on the clinical diagnosis of occlusal caries with currently available methods, such as visual inspection, tactile examination, fibre-optic transillumination, dyes, electrical resistance measurement, light-induced fluorescence, and conventional and digital bitewing radiography. A comparison of the various methods of occlusal caries diagnosis is made, together with an assessment of how they may influence the decision to institute preventive therapy or operative intervention of the occlusal surface.

Introduction

As occlusal caries is now estimated to account for approximately 80 per cent of all new carious lesions in children and young adolescents,[1-3] its diagnosis is of significant clinical importance. In spite of the fact that occlusal surfaces of molars and premolars are directly visible clinically, early occlusal lesions are difficult to diagnose. This is because most of the early stages of the lesion are hidden and currently no single diagnostic method has gained universal acceptance with regard to the ability to accurately diagnose early occlusal caries.[1] With the overall decline in caries prevalence in the Western world over the past two decades, there has also been a change in focus from diagnosing and treating frank occlusal carious lesions to having to evaluate more truly caries-free occlusal surfaces.[4] Removing the effect of the more advanced forms of occlusal caries where traditional diagnostic methods have performed well, has caused a shift in diagnostic emphasis. The clinician is now largely faced with caries presenting early in its pathogenesis where cavitation is not always a feature.

Diagnosis is becoming more important because of the increased availability of treatment options as a result of improved materials, together with greater patient awareness and expectations,[5] and the current greater preventative approach. As there is increasing recognition that even a small occlusal restoration is the first stage in the restorative process which may end in tooth destruction, there is greater pressure on the clinician to accurately diagnose the occlusal caries status of a tooth. For the early occlusal lesion, a

number of treatment options exist, including preventive therapy (including fissure sealants) or conservative restorative intervention.

The aim of this paper is to therefore review the efficacy of currently available clinical methods of occlusal caries diagnosis (using validity measures such as sensitivity* and specificity† where appropriate) and to suggest guidelines for use, together with applications in clinical practice. Owing to the paucity of studies in primary teeth, this review focuses predominantly on occlusal caries diagnosis in the permanent dentition.

The early lesion: nature and location

A visible or clinically detectable lesion is likely to have its initial enamel lesion located more superficially at, or near, the entrance to the fissure where dietary substrates and salivary buffers are readily available.[6] Poor oral hygiene, poor accessibility of saliva, plaque accumulation, lack of occlusal function and relatively shallow occlusal fissures may all contribute to the development of such lesions.[7] Clinically visible lesions are more likely to occur, for example, in slowly erupting teeth where access for oral hygiene and lack of occlusal function tends to favour plaque stagnation.[6]

In contrast, Juhl reported that 61 per cent of early lesions occurred on the walls of the fissure near its base, hidden from direct view.[8] Others have supported this finding.[9-12] Spread of these lesions into dentine may occur in the absence of freely available substrate and pH regulating buffers. It is theoretically possible, but not proven, that substrates in deep lesions originate from the pulp

*Ability to diagnose disease (carious occlusal surface) when it is present
†Ability to diagnose health (sound occlusal surface) when it is present

via dentine tubules, or from penetration through enamel.[13] The cariogenic bacteria may also adapt to a reduced substrate concentration, utilizing substrates from tissue fluid within the lesion. This would allow cariogenic bacteria to persist in deep, clinically obscured lesions enabling the caries process to continue.[14]

Why some occlusal lesions become less clinically obvious compared to others is largely unknown.[6] Fluoride was believed to have masked the spread of caries into dentine[15-18] because for a long time the development of clinically obscured lesions seemed to cohere with our current understanding of the mechanism of action of fluoride, in decreasing enamel solubility and promoting remineralization of the pit and fissure enamel. Thus caries could progress into dentine without any changes in the integrity of the overlying occlusal enamel. Whilst all forms of fluoride have certainly reduced the overall prevalence of dental caries, it is well known that fluoride in toothpastes and artificially fluoridated water has a more limited effect on pit and fissure surfaces compared with smooth surfaces.[19] Recent evidence also casts doubt on the fluoride hypothesis,[4] leaving the etiology of clinically undetected caries open to further debate.

Clinical methods of occlusal caries diagnosis

Our present clinical diagnostic tools for occlusal caries include both qualitative and quantitative methods (Table 1). Traditional methods include visual inspection, tactile techniques (mirror-light-probe combination), fibre-optic transillumination and bitewing radiography. More recent additions to this continuum include the use of caries detector dyes, digital radiography, electrical resistance measurement and light-induced fluorescence.

Table 1. Comparison of the various clinical methods of occlusal caries diagnosis.

	Qualitative methods						Quantitative methods	
Property	*Visual examination*	*Tactile examination (probing)*	*Fibre optic transillumination*	*Dyes*	*Conventional bitewing radiography*	*Digital radiography*	*Electrical resistance measure-ment*	*Light induced fluorescence*
Ease of use	Simple	Simple	Simple	Simple	Simple	More involved	More involved	More involved
Cost	Negligible	Minimal	Moderate	Low	Moderate	Very high	High	High
*Sensitivity**	Low to high	Low	Low	Low	Low to moderate	Low to Moderate	High	High
Specificity†	Low to high	Low	Low	Low	High	High	Moderate	Very high
Potential damage to fissures	No	Yes	No	No	No	No	No	No
Detection of early carious lesions	Poor to very good	Poor	Poor	Poor	Poor	Poor	Good	Very good
Detection of established (dentine) carious lesions	Poor to very good	Poor to good	Fair to good	Poor	Very good	Very good to excellent	Poor	Good
Predictor of invasive treatment needs	Moderate to poor	Moderate to poor	Moderate to poor	Poor	Very good	Very good	Poor	Poor
Ability to monitor lesion progression	Potentially very good to poor	Poor	Poor	Poor	Moderate to poor	Moderate to poor	Very good potential	Very good potential
Examples of instruments (commercial brands)	N/A	Hu-Friedy‡ (Sickle and straight explorers)	Denlight§	Cari-D-Tect‖	Kodak D (Ultra speed) and E (Ektaspeed Plus) film ¶ Max-FS** Heliodent DS††	Sidexis†† Heliodent DS††	Electronic Caries Monitor‡‡	DIAGNO-dent§§

*Ability to diagnose a carious occlusal surface
†Ability to diagnose a sound occlusal surface
‡3232 N.Rockwell St, Chicago, Illinois, 60618-5982
§Welch Allyn, 4619 Jordan Rd, Skaneateles Falls, New York 13153
‖Gresco Products, 13391 Murphy Rd., P.O. Box 865, Stafford, TX 7749
¶Eastman Kodak Company, Rochester, NY, USA
**Morita Corporation, 33-183-Chome-Trumi-Cho, Suita City, Osaka 564
††Sirona Dental Systems, Fabrikstra Be 31, D-64625 Bensheim Germany
‡‡ECM, Lode Diagnostic, Groningen, ECR, The Netherlands
§§KaVo EWL, Wangener Str. 78, 88299 Leutkirch, Germany

Visual inspection (VI)

The problem of accurately diagnosing occlusal caries status based on VI has been highlighted by laboratory studies where diagnoses were verified histologically (the so-called "gold standard").[20-23] Collectively these studies showed that even with ideal visual examining conditions, clinicians could still only detect between 20 and 48 per cent of dentine lesions.[12]

The low detection rate of traditional visual caries scoring methods may be ascribed to a number of factors. First, lesions are usually located on the fissure wall obscured from view rather than on the surface.[8] Traditional visual examination of occlusal surfaces seldom focuses on factors other than obvious cavitation, which for clinicians working at the cavitation level, results in far more false negative diagnoses (i.e. missing many early forms of occlusal caries). Second, there is a distinct lack of standardized clinical criteria of what constitutes caries and what does not. For example, the World Health Organization definition of caries is cavitation of the tooth surface, which is clearly of limited use clinically.[24]

A visual caries score system was recently proposed by Ekstrand and workers based on *in vitro* and *in vivo* correlations of clinical and histological appearance of lesions.[25-27] It was able to accurately detect occlusal caries and define lesion depths in both enamel and dentine (correlation coefficients, r_s, = 0.75 – 0.93, sensitivities 92 – 97 per cent, specificities 85 – 93 per cent). Used together with other relevant clinical observations (electrical resistance measurement and radiography), this scoring system increased the accuracy of

occlusal caries diagnosis. In fact, in a recent *in vitro* study of primary teeth, the performance of this scoring system was high enough that electrical resistance measurement, with which it was compared, did not provide any further increased accuracy over the VI method.[28] This method, which is based on the translucency and breakdown of enamel visible after air drying, emphasizes the importance of dehydration of the fissures for clear visual inspection. Drying the enamel surface permits air to contact it and therefore fill porosities, such as those due to demineralization. As the difference in refractive indices between air and enamel (0.62) is much greater than between water (saliva) and enamel (0.29), subtle appearances of the enamel become more appreciable.[29] To further improve visualization of the fissures, good lighting and binocular magnification using magnifying loupes are suggested. A disadvantage of this system however, is the prolonged period of training and familiarization involved.[26]

Tactile techniques

The "time-honoured method"[29] of probing of fissures using explorers dates back to G.V. Black[30] who believed that when a "very light pull" was required to remove the point of a sharp probe from a pit, the pit should be "marked for restoration", even though, quite clearly, there might not have been any other sign of caries. Although it has been demonstrated *in vitro* that a substantial number of sticky fissures are carious (i.e. probing has a high positive predictive value‡ for stickiness),[31] "stickiness" may also be a function of the morphological wedging effect of a sharp probe within the fissure system, as well as explorer tip size and force used.[32,33] Also, the examiner will not always withdraw the probe along the

‡Probability of disease (occlusal caries) when the test (probing) is positive

same path as was inserted, and lateral pressure may resist withdrawal producing a "false stick".[34] Thus probes may "stick" in many sound but deep fissures, giving false diagnoses.

The use of the probe and "stickiness " as the sole diagnostic criteria for occlusal caries is therefore unreliable. A more recent study using histological caries validation showed that only 24 per cent of carious lesions were discovered by probing for stickiness (i.e. low sensitivity), but that the probe seldom stuck in a sound fissure (i.e. specificity > 99 per cent).[35] It is obvious that many occlusal caries lesions are frequently missed by this tactile diagnostic method.

Beyond the inaccuracies of probing in occlusal caries detection, are the possible destructive, irreversible traumatic effects of this tool in demineralized areas.[36-38] This may occur when the fragile, demineralized enamel surface of an incipient subsurface lesion is destroyed, leading to cavitation. This situation would favour progression of a lesion that might otherwise have been arrested or stable.[5] The question of whether repeated probing of occlusal surfaces increases caries prevalence is a separate issue, and some evidence exists which suggests that it does not.[1] There has also been concern that probing may transplant cariogenic bacteria into the depth of an occlusal lesion from another site, although the extent to which this is believed varies,[5,34] and the evidence scanty. Hence the "sharp eyes but blunt explorer" approach is increasingly becoming that favoured by researchers in the field of caries diagnosis.[34,39]

In light of the many shortfallings of this technique it would seem plausible to discard the probe for occlusal caries diagnosis. However, the value of the

probe for this purpose lies in recognizing its limitations. The probe may augment diagnosis by other methods, such as visual inspection, by removing debris on occlusal surfaces, and by helping to decide whether or not there is cavitation such as using the probe to check for the leathery or tacky surface characteristics of the lesion.[34] The probe may also aid in the assessment of a visually inaccessible occlusal surface, such as may occur with partially erupted premolars and molars, and ectopically positioned teeth.

Fibre-optic transillumination (FOTI)

FOTI is an extension of the technique first applied to occlusal caries diagnosis by Dominkovic.[40] The technique makes use of the fact that carious tooth structure scatters light more strongly and thus has a much lower index of light transmission than sound tooth structure, and as such appears as a dark shadow.[28,41] The use of FOTI has mostly been with regard to interproximal lesions where assessments have been compared to radiographic determinations.[42-47] A clinical study in which FOTI was correlated with histological examinations showed FOTI to be of no increased value in detecting occlusal enamel lesions.[48] In another study, FOTI was shown to perform more accurately than visual as well as radiographic methods for the diagnosis of both deep and shallow dentine lesions, while radiographic detection was better for detecting deeper lesions.[49] Where operative intervention validated diagnoses, FOTI would often miss occlusal caries (i.e. low sensitivity), but when FOTI predicted small occlusal carious lesions, demineralization was usually present at these sites (i.e. high positive predictive value) and outperformed the clinical and radiographic

examination in this respect.[50] Despite the low sensitivity (13 per cent) of FOTI in the detection of occlusal dentine caries in this study, the diagnosis of a "sound" surface or absence of disease, was very good (i.e. specificity 99 per cent).[50]

The results therefore suggest that FOTI may be more useful for certain aspects of diagnosis, such as detecting moderate-size occlusal dentine lesions and identifying occlusal surfaces as "sound". In contrast, FOTI would appear less useful where there are early changes, such as those involving enamel or just into dentine, as considerable involvement of dentine appears necessary for accurate detection with this technique. The value of FOTI in occlusal caries diagnosis will need to be further established by more studies.

Dyes

The use of various dyes, fluorescent or non-fluorescent, have been used for staining the porous caries lesion in order to enhance contrast between the carious region and surrounding sound enamel.[41]

This approach to caries diagnosis historically began with a technique in which a fluorescent dye was applied to smooth and interproximal surfaces and the teeth examined under ultraviolet light to identify areas of enamel porosity.[51] The dye was apparently very sensitive for this application, however, it offered little in the way of *in vivo* occlusal caries diagnosis due to difficulties with use, questionable toxicological safety and lack of clinical standardization.[41,52]

Consequently, dyes have received little attention in the area of occlusal caries diagnosis, and their efficacy remains largely unestablished. Despite this, however, non-fluorescent, so-called "caries detector dyes" have emerged on the

market, purporting to discriminate infected dentine from partially demineralized (sound) dentine.[29,53] And whilst there may be some debate as to the usefulness of these particular dyes for this purpose,[29] they in fact have little role to play in the diagnosis of early occlusal lesions.

Electrical resistance measurement (ERM)

The value of ERM in caries diagnosis was first described as early as 1951.[54] The basis for the method is the increase in electrical conductivity due to a reduction in the mineral content of carious enamel.[55] Demineralization creates porosities that fill with saliva and form conductive pathways for electrical current.[41] Such demineralized enamel has measurable conductivity that increases with increasing demineralization.[56] Sound enamel provides high resistance to electrical current, and hence reduced conductivity. ERM is able to record these early changes.[57]

The Vanguard Electronic Caries Detector§ and the Cariesmeter L|| were the first commercially available devices utilizing this technology, and were essentially developed in the search for a method by which the formation and progress of very early demineralization in the fissure could be monitored. Sensitivities and specificities have generally been moderately high with these devices.[50,55]

Despite this, the biggest problem with these machines remained an unacceptable level of false positive diagnoses, a particular concern when the device was used to decide whether or not to treat a suspected carious lesion by operative intervention. A high number of sound surfaces would be treated

§Massachusetts Manufacturing Company, Cambridge, MA, USA
||Onuki Dental Co. Ltd., Japan

unnecessarily in this case.[55] These instruments have largely been superceded by the Electronic Caries Monitor (ECM)¶, a device which is reported to have overcome the problems with the earlier devices, largely that of airflow around the tip which greatly affects measurements.[55] Instead, a coaxial airflow is incorporated into the tip, the resistance of the tooth being measured where touched by the probe as the surrounding enamel is being dried. This has reduced the number of false diagnoses, although some researchers believe specificity still remains lower than required of a new diagnostic technique and that ERM should not be used to decide when to treat a caries lesion invasively.[58]

The ECM has been the subject of many recent *in vitro* and only a few *in vivo* studies, most of which have used histology to validate the diagnoses. Collectively, they show that sensitivities range from 58 to 95 per cent, and specificity 73 to 94 per cent.[26, 59-61] In one histologically validated *in vivo* study of the ECM, correlation analysis indicated a moderately high relationship (correlation coefficient, r_s = 0.71) between ERM and actual lesion depth.[27]

It also appears that the mineral content of the enamel contributes largely to the reading or is probably more important in resistance measurements, than lesion depth *per se*.[55] Once caries has extended beyond the dentino-enamel junction (DEJ), little or no change in resistance values occurs with the progressively deeper lesions in dentine. Thus another disadvantage of the ECM is its failure to differentiate dentine lesions of varying depths. At present it appears to perform better in detecting those lesions at or around the DEJ,[50,55] i.e. small enamel and early dentine lesions, that might otherwise be overlooked in

¶Lode Diagnostic, Groningen, ECR, The Netherlands

conventional visual and radiographic examination. Thus the ECM may be of particular value in differentiating occlusal lesions confined to enamel from those involving both enamel and minimal dentine.

Considering these limitations, and by virtue of its quantitative nature, ERM could be regarded as a supplementary aid in identifying and possibly monitoring occlusal sites where non-invasive intervention is suggested. Whilst the latter would be useful clinically, studies are yet to fully establish this, together with the influence of operator, tooth and equipment factors on the interpretation of measurements (Table 2).

Light-induced fluorescence

A surface or object is said to fluoresce when it appears as though it itself were emitting light when a light source is directed at it. It is well known that dental enamel and dentine fluoresce when excited by light in both the ultraviolet (long-wavelength) and visible (short-wavelength) range of the spectrum, and that this fluorescence is different for both sound and carious tooth substance.[62] The exact nature of the fluorescing chromophores is presently unknown.[63] Demineralization results in a loss of fluorescence,[64-66] and the difference in fluorescence between carious and sound tooth tissue is much greater in enamel than it is in dentine where the change is much less, or even barely perceptible.[65] Furthermore, the loss of fluorescence that accompanies a reduction in mineral content of tooth tissue (namely enamel) is much more appreciable for light in the visible range, compared with long-wavelength light sources.[65,67]

Table 2. Potential factors influencing use and interpretation of the various clinical methods of occlusal caries diagnosis.

	Qualitative methods						**Quantitative methods**	
	Visual inspection	*Tactile examination*	*Fibre optic transillumination*	*Dyes*	*Conventional bitewing radiography*	*Digital radiography*	*Electrical resistance measurement*	*Light induced fluorescence*
OPERATOR FACTORS	Visual acuity Use of magnification	Probing pressure Path of insertion and withdrawal	Tip angulation Ambient light	Selection of dye Interpretation of staining Washing protocol	Visual acuity Ambient light	Visual acuity Ambient light	Tip placement Tip location in relation to fissures	Tip angulation Tip location in relation to fissures Ambient light Calibration technique Interval between calibration
TOOTH FACTORS	Plaque Calculus Stains Saliva (wet Vs dry field) Oral debris Restorative or sealant materials	Shape, width and depth of pits & fissures Restorative or sealant materials Developmental tooth defects	Thickness of enamel & dentine	Depth of fissures Oral debris, plaque, calculus Restorative materials	Developmental tooth defects (enamel hypoplasia etc) Restorative materials Buccal or lingual surface caries Enamel/dentine thickness	Developmental tooth defects (enamel hypoplasia etc) Restorative materials Buccal or lingual surface caries Enamel/dentine thickness	Moisture and saliva Stains Calculus Plaque Restorative or sealant materials Thickness of enamel Depth of lesion (dentine Vs enamel only)	Moisture and saliva Stains Calculus Plaque Restorative materials Developmental tooth defects (enamel hypoplasia etc)
EQUIPMENT FACTORS	Light intensity Ambient light Clinical criteria	Sharp vs blunt explorer	Light intensity at tip Diameter of tip fibres	Dye volume applied	Exposure time Kilovoltage & Milliamperage (mA) of X-ray machine Concentration of solutions Processing time Processing procedure (developing/ fixing/water rinsing) Processing temperature	Software (image manipulation) Exposure time Kilovoltage & Milliamperage(mA) of X-ray machine Film resolution (lines/mm) Screen resolution (pixels/mm)	Coaxial airflow Electrical current Temperature effect Resistance	Wavelength of light Optical purity (monochromaticity) Stability of light emission Autoclaving effects on optical components

It has been demonstrated that, in contrast to sound enamel which appears luminescent and fluoresces in the orange/yellow region of the spectrum, incipient and well-developed carious lesions appear as dark areas when excited by laser light at the 488nm (visible blue) wavelength and observed through a yellow high-pass filter.[65] The reason why caries appears this way is because it fails to fluoresce and thus contrasts well with the surrounding sound, fluorescing tooth structure.

It is not surprising then that the fluorescence phenomena has been used as a means of diagnosing dental caries,[52,63,65,66,68,69,71-74] and has given rise to the term "quantitative light-induced fluorescence", or QLF.[55] QLF essentially involves quantifying the actual fluorescence loss in the caries lesion, usually expressed as a percentage change in mean fluorescence radiance.[63] It has been shown that not only does this parameter correlate well with mineral loss in enamel, but also with the histological depth of the lesion.[63]

Whilst it has been shown that QLF can detect many more demineralized occlusal surfaces than clinical examination alone (9.5 times as many in fact) when performed *in vivo*,[69] it has proven difficult to validate these findings using histology (the "gold standard"). The results of QLF in other clinical studies have either been compared to bitewing radiography[75] or validated using operative intervention.[76] The only known study to date using the latter to validate QLF involves the newly developed and commercially available visible red (wavelength 655nm) diode laser system, DIAGNOdent**, designed specifically for clinical caries diagnosis.[76] In this clinical study, DIAGNOdent was found to have detected

**KaVo EWL, Wangener Str. 78, 88299 Leutkirch, Germany

occlusal caries in all 55 posterior teeth (13 per cent of lesions restricted to enamel and 87 per cent to dentine) with a positive QLF diagnosis, but where clinical diagnosis (based upon examination and radiography) was doubtful.[76] Unfortunately, specific conclusions about sensitivity and specificity cannot be drawn from this study as there was no operative intervention to assess for caries in instances where a negative QLF diagnosis occurred. However, other studies using extracted teeth have generally found that the QLF method of diagnosis, including DIAGNOdent, generate much higher levels of sensitivity and specificity than the currently available techniques.[68,77] In a comparison of DIAGNOdent with the ECM, it was found that the QLF approach produced *in vivo* sensitivity (90 per cent) and specificity (82 per cent) values similar to those obtained from ECM.[78]

What remains to be investigated, nevertheless, is the influence of tooth factors such as fissure morphology, saliva, stains, calculus, plaque and restorative materials (Walsh LJ, 1999, personal communication) on QLF in occlusal caries diagnosis. Equally important also is the role of operator and equipment factors, both of which have received relatively little attention (Table 2). Another concern has been the cut-off levels between sound and carious tooth structure, since this ultimately determines whether or not to intervene operatively (e.g. exploration with a fine bur or air abrasion). Unfortunately this has largely been determined arbitrarily from relatively unstructured observations than from large rigorously designed studies (Walsh LJ, 1999, personal communication). The situation in which teeth might yield readings close to the threshold is a particular concern, since it is not clear how reproducible these measurements are

over time. In one study whereby examiners assessed extracted teeth twice,[79] it was concluded that reproducibility of DIAGNOdent was very good. Although clinical environments are less well controlled, most studies suggest that QLF is at least capable of quantifying changes in artificial demineralization severity in enamel sections *in vitro*.[80]

Despite the limitations of *in vitro* studies using extracted teeth, a recent study has confirmed the better overall performance of QLF using an argon laser compared to conventional visual examination alone, in diagnosing demineralization in occlusal pits and fissures.[68] Results of QLF in this instance were validated using histology. The only diagnostic technique to outperform QLF in terms of sensitivity was dye-enhanced laser fluorescence. The relevance of this finding is questionable, however, since the latter technique is not as yet clinically applicable in its current state. Interestingly, visual assessment and QLF were found to perform equally well as diagnostic methods when colour of fissures was included as an indication of demineralization in the visual exam.[68] In a clinical study on school children, the laser fluorescence examination detected more caries-like changes in the enamel than did either the "mirror and probe approach" or bite-wing radiography,[75] a fairly indicative finding of studies thus far.

Conventional bitewing radiography

Bitewing radiography has traditionally been considered of little or limited value in the diagnosis of occlusal caries. Unlike interproximal caries diagnosis, it was believed that superimposition of buccal and lingual enamel on the fissure system made the task difficult.[29] Despite this however, a number of studies have since confirmed the usefulness of bitewing radiography for this purpose, using either D- or E-speed radiographic film, which provide comparable diagnostic performances.[81]

In discussing radiographic detection of occlusal caries it is important to differentiate the early occlusal lesion from those that are more advanced or established. Early occlusal lesions may be those involving enamel only, or those that exist at or around the level of the DEJ. A number of studies have shown that when conventional bitewing radiography is validated histologically or operatively, it performs either questionably or poorly in the detection of early occlusal carious lesions.[26,50] The explanation for this is that occlusal lesions need to have progressed clearly into dentine before they can be perceived on a radiograph.[81] Thus bitewing radiography cannot detect occlusal caries early in its pathogenesis.

For the detection of occlusal lesions into dentine however, the performance of radiography is quite different. A number of *in vitro* studies using histological validation, have shown that specificity of bitewing radiography, or the detection of a caries-free occlusal surface, is very high (80 to 100 per cent) and always exceeds sensitivity (19 to 56 per cent), or the detection of occlusal

caries.[22,26,59] Admittedly sensitivity is not as high as is ideal for a diagnostic tool, but when compared to the detection of early lesions, bitewing radiography certainly outperforms. *In vivo* studies using either histology or operative intervention have generally produced similar results, albeit of a somewhat lower magnitude of sensitivity (58 to 67 per cent) and specificity (66 to 92 per cent).[22,50,60] Where radiography has been correlated with histology or mineral loss, studies have indicated a moderate to strong relationship between the two, suggesting that bitewing radiography performs over quite a range in occlusal caries detection, depending on the conditions of the study.[26,27,82] Therefore, when the emphasis is on detection of a sound occlusal surface, radiography is quite useful, but when the emphasis is on detection of occlusal caries, the radiographic method alone is less ideal.[41] A recent study of the influence of exposure factors on occlusal caries diagnosis has also shown that sensitivity increases with film density and specificity is higher with light radiographs.[83] This suggests that occlusal caries is diagnosed best from the relatively darker radiographs, and that under-diagnosis is more frequent with light radiographs.

Nevertheless, the importance of this diagnostic tool in the detection of occlusal caries has been emphasized by the increasing recognition of occlusal lesions which occasionally escape routine clinical detection by visual and tactile methods, but which are clearly visible in dentine on a radiograph.[84-91] These lesions have been referred to as occult[15,16] or hidden caries,[6,14,86,87,92,93] and have typically involved permanent first and second molar teeth. Clinically these teeth

present with intact occlusal surfaces, and range in prevalence from 1.2 to 50 per cent.[5,90,91] Although there is evidence to suggest the clinical criteria used to judge the teeth in these studies may have resulted in a higher than expected proportion of occlusal dentine lesions going undetected,[26,88,90] and that some of these lesions might not have actually been caries *per se*,[94] the fact remains that conventional bitewing radiography can reliably disclose the progressively deeper occlusal lesions where cavitation of the occlusal surface is either minimal or may not have yet occurred.[21,22,100] It is not surprising then that it has been suggested that bitewings are necessary for a full diagnostic screening and identification of occlusal caries in teeth that may appear sound by conventional clinical examination.[37]

Digital radiography

Digital acquisition of intra-oral radiographs has been made possible over the last decade. Direct digital radiography (DDR), as opposed to a digitized film radiograph, is believed to possess a number of advantages over conventional film-based radiography. As a direct digital image is achieved via computer, the process is more efficient and the image dynamic, which has given rise to the main advantages of this system over traditional radiography. These include (semi) real time imaging, image manipulation (image enhancement via changes in density and contrast, subtraction radiography and image reconstruction) and image storage and communication via digital networking.[95,96] Other advantages include lack of chemical processing and the fact that the sensors used (charge-coupled device and storage phosphor systems) require between 5 and 50 per

cent of the dose needed for conventional radiography to create an acceptable image.[95]

Unfortunately, most studies thus far have evaluated their diagnostic performance only in laboratory settings, with a distinct lack of controlled clinical studies. There are still many unanswered questions with DDR, such as whether the number of retakes has been reduced, whether proper cross-infection control can be maintained with the systems, how stable DDR is in daily clinical use and furthermore, whether diagnoses, working practices or treatment decisions have changed.[95]

The few studies that have assessed the efficacy of DDR with regard to occlusal caries diagnosis have been *in vitro*. Those validating the results of DDR with histology have shown that DDR performs as well as[59,91] or better than conventional bitewing radiography[21] in terms of both sensitivity (19 to 74 per cent) and specificity (89 per cent). In fact in one study, DDR was able to detect over 70 per cent of deep occlusal dentine lesions in teeth free of cavitation, in contrast to only 45 per cent by conventional film-based bitewing radiography and xeroradiography, without an increase in false positive diagnoses.[21] However, DDR could not detect early (enamel) occlusal lesions. Xeroradiography, which entered the field of dental diagnosis in the 1970's, was developed on the basis that it was twice as sensitive as conventional D-speed films and cheaper in use.[81] However, although the technique had proved popular, the lower dose and edge-enhancement features were soon overtaken by the more efficient digital imaging systems.

As far as DDR is concerned, its role in occlusal caries diagnosis seems promising and further studies are needed to establish whether it should replace conventional bitewing radiography, considering also other diagnostic uses for which it would need to perform acceptably in the clinical setting. It is yet to be established whether fine-tuning the DDR systems could allow for the detection of the early occlusal carious lesion.

Comparison of the various diagnostic methods (Table 1)

Many attempts have been made to compare the overall performance of the currently available diagnostic methods with regard to occlusal caries. No more convincing however are the results of meta-analysis, a very powerful statistical tool for comparison. Probably the most well known study using meta-analysis is that by Ie and Verdonschot.[97] In this analysis, nine *in vitro* and one *in vivo* studies were compiled up to 1993. Collectively, this study showed that ERM and FOTI had a comparatively good performance in occlusal caries diagnosis, and visual inspection and xeroradiography a poor performance. Digital and conventional bitewing radiography had intermediate performances. At least for the diagnosis of early occlusal lesions, it is clear that ERM is more sensitive than traditional visual-tactile examinations and radiography alone.[49]

A more recent attempt was made to compare the results of seven studies of occlusal caries diagnosis, mostly published since that time, using the newer visual scoring method, radiography and ERM, and found the former to perform

the highest, whilst ERM also performed highly and radiography moderately well.[98] All studies used histological validation.

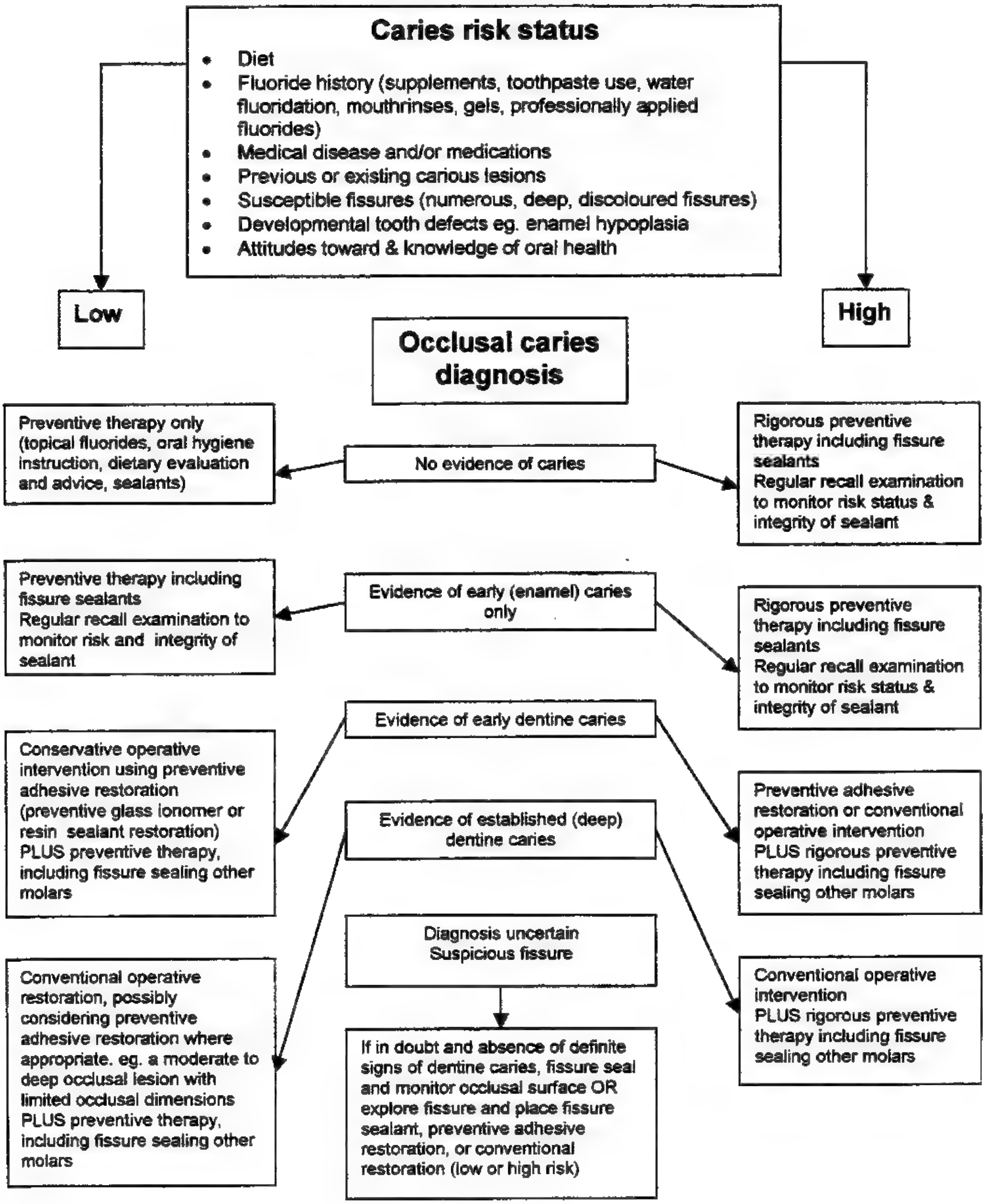
Unfortunately little can be said of QLF in relation to these diagnostic methods, although it is more than likely similar in performance to ERM or the newer visual inspection methods. No comparison is made of caries detector dyes, although considering previous evidence, it is most likely a poor performer.

More importantly, comparative studies have highlighted the fact that when combined, the various diagnostic methods usually act synergistically, that is, together they reveal more about the true caries status of a tooth than when applied in isolation. For example, the addition of conventional bitewing radiographs to visual and tactile examinations significantly improves the accuracy (sensitivity and specificity) of fissure caries diagnosis in non-cavitated teeth.[22,27,99]

Management of the occlusal surface: prevention or operative intervention? (Figure 1)

Having considered the methods of occlusal caries diagnosis, the next logical step is to apply these tools in a relatively structured manner to the clinical setting, insofar as how an occlusal surface might be managed. A number of authors have provided specific guidelines in this respect, and presented here is a modified version of that proposed by Elderton[100] and De Craene et al[101] (Fig. 1).

Figure 1. Flow diagram of the clinical criteria important in the management of the occlusal surface and possible treatment strategies.



A number of factors have a direct bearing on the process of deciding which particular treatment best applies to a given tooth or individual. These factors are discussed below.

1. Diagnostic test outcome

The results of the various diagnostic methods considered thus far are probably the single-most important in the decision making process toward management of the occlusal surface, whether this involves preventive therapy or operative intervention. For example, ERM or QLF may assist in detecting those early lesions not visible to the naked eye which would benefit from preventive interventions, such as oral hygiene instruction, professionally applied and at-home use of fluoride preparations, fissure sealing, dietary counselling and regular monitoring. Similarly, bitewing radiography may determine the need for operative intervention by identifying those occlusal dentine lesions that might have otherwise escaped detection by other diagnostic means.

As even the most accurate diagnostic method will fail at some point in time, it is important that where diagnostic methods are inconclusive or where there may be doubt as to their accuracy, the best option is to either fissure seal the occlusal surface or undertake fissure exploration in the absence of definite signs of dentine caries,[102] particularly if the patient is not strictly low caries risk. It has been shown that occlusal lesions not visible in dentine on a bitewing radiograph harbour so few bacteria that the likelihood of sealing significant numbers of cariogenic microorganisms is not a concern.[103] Numerous studies have also demonstrated that fissure sealing significantly reduces the long-term

number of cariogenic bacteria within the fissure system when the sealant remains intact.[104] Thus the concern that caries may be inadvertently "sealed-in" is unfounded and no longer an issue. This effect of sealants on enamel and even very early dentine lesions has reported to be attributable largely to the barrier effect, that is, the ability to block nutrients from bacteria within the tooth. The acid-etching process and the inherent reparative capacity of dentine are also thought to be important in this respect.[104]

There is no doubt however that occlusal lesions into dentine on a radiograph require operative intervention using conservative, preventive adhesive restorations or conventional cavity preparation. Nevertheless, some researchers have advocated a more "ultraconservative" approach to such lesions involving the use of so-called cariostatic sealed restorations in which composite resin materials and fissure sealants are placed directly over occlusal dentine lesions.[105] This practice has far from received universal acceptance and ought to be approached with caution, because should the sealant fail, the caries process already has a "head start", and radiographic monitoring of dentine lesions is questionable.[6] The studies from which these rather optimistic recommendations were made also represented lesions with frank or clinical cavitation. This is an important distinction, since cariogenic bacteria in dentine lesions presenting with intact occlusal enamel surfaces are probably not as susceptible to the etchant effects as bacteria in cavitated lesions, owing to the likelihood of the acid etchant not reaching the infected dentine.[6] Furthermore, it is possible that bacteria in such clinically undetected lesions may flourish by deriving nutrition from the

dental pulp, rather than the immediate external oral environment. A suggestion that this may be possible comes from one particular study which found that where occlusal dentine lesions were accidentally fissure-sealed because of clinically sound occlusal enamel surfaces, a significant number with intact margins both clinically and under scanning electron microscope had cultivable levels of microorganisms approximately 3.4 years after sealant placement.[14] Another earlier study found similar results, with cultivable organisms being detected at periods of up to, and in excess of, two weeks in moderate to deep dentine lesions.[106]

2. Factors influencing the various diagnostic methods

Not only is it important to appreciate the limitations of the diagnostic tools, but also to consider those factors that may influence their use and interpretation (Table 2). For example, the combination of poor lighting, lack of binocular magnification, and an occlusal surface covered with plaque & oral debris in a wet field typifies the worst, but probably most familiar, of clinical scenarios across the entire range of diagnostic methods. It is important therefore that the most ideal situation is created, as far as is clinically possible, in order that each method be applied in the correct manner for which it is intended. This will reduce false positive diagnoses and thus avoid operative intervention where a tooth is sound.

3. Caries risk

Another factor to consider in the management of the occlusal surface is the caries risk of an individual. A number of factors may constitute "caries risk". These include diet, oral hygiene, fluoride history (including water fluoridation and use of topical fluorides), history or presence of medical disease and certain medications, evidence of previous or existing caries, susceptible (numerous, deep, stained) fissures, and attitudes toward, and knowledge of, oral health.[101,107-111] The lower the caries risk of an individual the higher the occurrence of false-positive caries diagnoses, and the more these will outweigh true positives.[81] This effect must be taken into account when deciding on operative intervention,[112] as it essentially means that in a low caries risk patient a clinician is more likely to unnecessarily restore an occlusal surface simply because of the greater chance of a false diagnosis, compared to a high caries risk individual. All diagnostic methods considered, for a high caries risk individual it may be more appropriate therefore to intervene operatively using fissure exploration, whereupon it may be decided to either fissure seal the tooth (invasive sealant) or place a preventive adhesive or conventional restoration depending on the final appearance of the fissure, the size of the restorative cavity, and the cooperation of the patient.[102] Such action may not be justified in a low caries risk individual. In this instance, it may be more appropriate to fissure seal the occlusal surface, and re-assess caries risk status at frequent recall examinations.

Conclusions

1. Visual inspection emphasizing clean, dry and well-illuminated teeth, electrical resistance measurement and light-induced fluorescence are proving valuable in occlusal caries detection over the more traditional approaches, especially with regard to early, non-cavitated lesions (small enamel and dentine lesions). Tactile techniques, fibre-optic transillumination, conventional and digital bitewing radiography are much less useful in this regard because they rely on significant pathological destruction of tooth structure. Their place in diagnosis is therefore in the detection of the more established, occlusal dentine lesions. The so-called caries detector dyes provide little information in either regard. The potential preventive benefits to early diagnosis with the first three methods are obvious.
2. No method ought to be abandoned or applied in isolation, but rather all provide varying amounts of information relevant to occlusal caries diagnosis. No single method will provide all the answers. It is important nonetheless, that the clinician develop a clear understanding of the unique features, strengths and weaknesses of each method in order that they are used to their best diagnostic advantage.

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PREDICTION OF OCCLUSAL DENTINE RADIOLUCENCIES ON BITEWING RADIOGRAPHS BY CLINICAL EXAMINATION OF UNSEALED AND SEALED PERMANENT MOLAR TEETH

Matthew S. Fracaro BDS,

W. Kim Seow BDS, MDSc, PhD, DDSc, FRACDS,

Lynette H. McAllan BDSc, LLDS,

David Purdie, BSc, MMedSc, PhD

Abstract

Purpose: This prospective study aimed to correlate a clinical examination of occlusal surfaces of unsealed and sealed first and second permanent molar teeth based on visual-tactile methods, with results of conventional bitewing radiography, in the detection of occlusal dentine radiolucencies.

Methods: Subjects were 481 children aged 5 – 12 years randomly selected from a dental clinic within a school-based dental service. Occlusal surfaces of first and second permanent molar teeth were examined clinically and scored using specific criteria based on the translucency and breakdown of enamel and fissure colouration visible after air drying. Fissure-sealed teeth were further scored clinically according to sealant integrity and presence or absence of clinically detectable occlusal caries. Bitewing radiographs exposed at clinical examination were assessed for the presence and extent of radiolucencies within dentine beneath the occlusal surface.

Results: Subject prevalence of dentine radiolucencies in teeth clinically scored as sound was 10% (n=48, 95%CI: 7.5% – 12.9%). Of the 1929 teeth in the study, 72 (3.7%) exhibited dentine radiolucencies beneath clinically sound occlusal surfaces. There was a significant difference in the prevalence of lesions among unsealed molars (n=38, 2.5%) compared with fissure sealed molars (n=34, 7.8%) ($P<0.05$). Dentine radiolucencies beneath clinically sound occlusal surfaces were not significantly associated with gender, age at examination, medical conditions, fluoride exposure and sealant integrity ($P>0.1$). The presence or absence of an occlusal dentine radiolucency on a bitewing radiograph was significantly

associated with the clinical scoring of the occlusal surface with respect to caries status ($P<0.05$).

Conclusions: A clinical examination of clean, dry and well illuminated teeth based on visual-tactile characteristics can usually predict the presence or absence of a dentine radiolucency on a bitewing radiograph. In 3.7% of teeth the occurrence of a dentine lesion on a radiograph is not readily identifiable from a clinical examination alone.

Introduction

As occlusal caries is now estimated to account for approximately 80% of all new carious lesions in children and adolescents,[1-3] its diagnosis is of significant clinical importance. However, in spite of the fact that occlusal surfaces of molars and premolars are directly visible clinically, a number of studies of adolescents and young adults have shown that a clinical examination may fail to detect anywhere between 0.8 to 50% of radiographic occlusal dentine lesions.[4-11] Among fissure sealed permanent molars, the proportion of radiographically detected occlusal dentine lesions may even be as high as 32 to 58%.[10,12] Occult[13,14] or hidden caries [8,9,11,15-18] are the terms used to describe radiographic dentine lesions immediately beneath clinically sound occlusal surfaces of molars and premolars. Unfortunately, little information is available on the prevalence of such lesions in young children and, therefore, the appropriateness of current clinical approaches to the diagnosis of occlusal caries.

The large variability in the reported prevalence of occult lesions suggests that traditional clinical methods of diagnosing caries based on mirror-light-probe combination are of questionable accuracy. A recent study using histological validation showed that only 24% of occlusal carious lesions can be discovered by probing.[19] Thus many occlusal lesions are frequently missed by this common tactile diagnostic method. Similarly, the problem of accurately diagnosing occlusal caries status based on visual inspection has been highlighted by laboratory studies where diagnoses were verified histologically.[20-23] Collectively these studies show that even under ideal visual examining conditions, clinicians

could still only detect a small proportion of dentine lesions. This may partly be because most early occlusal lesions begin at the base of the fissure wall, hidden from direct view.[24] In addition, there is a distinct lack of standardized clinical criteria of what constitutes caries.

Concern has also been expressed regarding the accuracy of occlusal caries diagnosis by conventional (as opposed to digital) bitewing radiography.[25] Radiographs may not be as accurate in detecting occlusal dentine caries, especially early lesions, compared with newer diagnostic methods such as electrical resistance measurement and light-induced fluorescence.[26-28] However, the use of conventional bitewing radiography in conjunction with visual-tactile examination has been shown to significantly improve the accuracy of fissure caries diagnosis, particularly in teeth without macroscopic cavitation.[21,22,29] A more recent *in vivo* study combining a newer visual scoring system and bitewing radiographs, accurately diagnosed the occlusal caries status when validated histologically.[30] Of interest is that in an earlier *in vitro* study using a similar visual scoring system, no radiographic dentine lesions were identified beneath clinically sound occlusal surfaces.[31]

Despite newer methods of occlusal caries diagnosis and the problems associated with traditional approaches, bitewing radiographs and the mirror-probe-light combination are still the most ubiquitous of those currently available in clinical practice. The purpose of this prospective *in vivo* study was, therefore, to correlate a clinical examination of occlusal surfaces of unsealed and sealed

permanent molar teeth based on visual-tactile methods, with conventional bitewing radiography, in the detection of occlusal dentine radiolucencies.

Methods

Subjects

The subjects were 481 school children in grades 1 to 7 aged 5 to 12 years attending the Oral Health Education Unit in Brisbane, Australia, between April 1999 and March 2000. Subjects were selected on the basis of attending any one of twenty-six schools within the catchment area of the Unit and providing parental consent for routine clinical and radiographic examination. Participation rate was approximately 74%, which reflected the general consent rate for examination at the Unit.

Information provided by the child's parent on the routine personal history forms such as name, sex, date of birth, exposure to water fluoridation, fluoride supplementation, age at commencement of fluoride toothpaste use and medical history, was noted. Records of subjects were also examined with respect to the date on which fissure sealants were placed. Operators were blinded to the personal details of each patient with respect to both the clinical examination and assessment of bitewing radiographs.

Clinical assessment of erupted molars

Unsealed teeth

The teeth examined in this study were erupted first and second permanent molar teeth. Teeth were examined and scored *in vivo* by one of five operators with respect to the appearance of the occlusal surface after air drying (> 5 secs) using the dental triplex syringe, Hu-Friedy* sickle explorer and dental mirror

*3232 N.Rockwell St, Chicago, Illinois, 60618-5982

under dental operating lights, without magnification, and using set fissure criteria which were a modification of Ekstrand's system (Table 1).[30,31] The occlusal fissures were dehydrated and visually inspected, and the translucency and breakdown of enamel and fissure colouration noted. Emphasis was placed on the importance of first matching the visual appearance of the occlusal surface with set fissure criteria, after which an explorer was then carefully inserted into the fissures to continue the assessment. Operator judgements regarding the caries status of the occlusal surface were avoided to minimize bias.

Sealed teeth

Where occlusal surfaces were fissure sealed, teeth were scored according to set sealant criteria (Table 2). Sealant integrity was judged under the same clinical conditions as described above, and scored as either partially or completely retained depending on visual and tactile (dental explorer) characteristics. Presence or absence of dentine caries in association with partially retained sealants was also noted. Completely missing sealants were scored according to non-sealed fissure criteria (Table 1).

With regard to sealed molars, respective subjects' dental charts were examined to identify whether these teeth had previous history of operative intervention not obvious by clinical examination alone, such as invasive sealing or preventive adhesive restoration. It is possible that these procedures may have affected the interpretation of bitewing radiographs of sealed molars due to the effects of either radiolucent dental materials, such as sealants or glass ionomer cements, or the leaving of a relatively less mineralized layer of dentine during

Table 1. Fissure criteria used in the clinical assessment of the caries status of the occlusal surface of first and second permanent molar teeth (Modified from Ekstrand et al [30,31]).

Score	Description
C0	Absence of all below features **= Non-carious***
C1	Pit/fissure discolouration only (a visible dark line or point within or along margins of the pit/fissure system visible after complete air drying [> 5 s]) **= Suspected enamel caries***
C2	Pit/fissure demineralization only (a white zone along the margins of the pit/fissure system visible after complete air drying of the occlusal surface [> 5 s]) **= Enamel caries***
C3	Pit/fissure discolouration and demineralization of the occlusal surface **= Enamel caries***
C4	Smallest perceptible break in the occlusal enamel pit/fissure surface detectable (i) with an explorer (a clinical 'catch) or (ii) where resistance is felt to withdrawal of an explorer within the pit/fissure system ('sticky") or (iii) where such a break is visually discernable due to localized enamel breakdown in opaque or discoloured enamel and/or greyish discolouration from the underlying dentine **= Early dentine caries***
C5	Frank cavitation into occlusal dentine either (i) visually detectable or (ii) where an explorer moves freely within the defect **= Established dentine caries***

* Clinical interpretation (not included in the clinical scoring of teeth to avoid operator bias)

Table 2. Sealant criteria used in the clinical assessment of the occlusal surface of fissure sealed first and second permanent molar teeth.

Score	Description
F0	No visible loss of occlusal sealant (no exposed fissures), absence of sharp margin ('catch') detectable with an explorer and absence of occlusal dentine caries.
F1	Partial loss of sealant (detectable with an explorer as a sharp margin or by visual inspection exposing the fissure) and absence of occlusal dentine caries.
F2	Partial loss of sealant (detectable with an explorer as a sharp margin or by visual inspection exposing the fissure) directly associated with frank cavitation into occlusal dentine.

caries removal. Therefore, only true fissure sealed molars (without operative intervention) were included in the study.

Teeth were excluded from the study if clinically they showed any of the following:

1. Caries on non-occlusal surfaces, such as buccal, lingual and interproximal .
2. Evidence of restorations
3. Enamel hypoplasia or hypomineralization
4. Inability to assess the entire occlusal surface, such as evidence of partial eruption and/or accumulation of oral debris/plaque.
5. Tooth cusp fracture
6. Tooth wear, such as erosion or attrition

Radiographic assessment

Radiographic technique

Conventional bitewing radiographs were exposed and processed as part of the routine examination procedures for each child. Bitewing radiographs were taken with Phillips† Oralix 65s and DensOMat apparatus (65kVp, 7.5mA, 50/60Hz, 240V) using size 22 mm x 35mm Super Poly-Soft Kodak‡ Ultraspeed film and Rayvue Bitewing Film Holders§ for an exposure time of 0.42 secs, and processed manually according to manufacturer's guidelines.

† GENDEX division, 901 W.Oakton St, Des Plaines, IL 60018 – 1884, USA
‡ Eastman Kodak Company, Rochester, NY, USA
§ Xray Supplies Pty Ltd, Hornsby NSW, Australia 2077

Scoring of bitewing radiographs

Bitewing radiographs were assessed by one of the authors (MSF) under 2 X magnification in a dark room using a standard radiographic illuminating box, and a sheet of black cardboard to remove peripheral light. First and second permanent molar teeth were scored with regard to the radiographic appearance of the occlusal surface, namely, the presence or absence of a distinct radiolucency within dentine immediately beneath the occlusal surface (Table 3). The operator was blinded to the results of clinical assessment of these teeth.

Teeth were excluded from the study if radiographically they demonstrated any of the following:

1. Poor quality radiographs
2. Restorations
3. Proximal radiolucencies

Special attention was also made to ensure that true occlusal radiolucencies in dentine were distinguished from buccal pits, which usually show a vertical linear radiolucency.

Definition of "clinically sound"

Use of the term sound was avoided during the clinical examination of teeth to remove operator bias with respect to the assessment of the caries status of the occlusal surface. The term sound was therefore applied after the clinical examinations, and referred to those occlusal surfaces of first and second permanent molars, unsealed or sealed, judged not in need of restoration (either conservative or conventional).

Table 3. Radiographic criteria used in the assessment of the occlusal surface of first and second permanent molar teeth.

Score	Description
R0	No radiolucencies in dentine immediately beneath the occlusal surface
R1	Distinct radiolucency in the outer third of dentine immediately beneath the occlusal surface
R2	Distinct radiolucency extending to the middle third of dentine immediately beneath the occlusal surface
R3	Distinct radiolucency extending the full thickness of dentine immediately beneath the occlusal surface

This reflected the need to apply a working definition in the context of clinical practice, and for the purpose of analysis, referred to fissure scores C0, C1, C2 and C3 (Table 1), and sealant scores F0 and F1 (Table 2).

Standardization of techniques

Prior to the clinical examinations, the five operators were trained and standardized with respect to both the clinical methodology, and clinical scoring systems, using 10 extracted third permanent molar teeth stored in saline. These teeth represented each of the different appearances of the occlusal surface of both unsealed and sealed teeth (Tables 1 and 2) and were examined twice by all five examiners on two separate occasions for the purpose of determining intra- and inter-operator variability (Table 4). The Weighted Kappa scores[32] were estimated at 0.94 and 0.84 respectively.

Intra-operator variability for the radiographic assessment was determined by one of the authors (MSF) scoring on two separate occasions, 10 sets of bitewing radiographs that were not part of the present study. The Weighted Kappa score for intra-operator variability was 1.0.

Table 4. Intra- and inter-operator variability for the clinical assessment of first and second permanent molar teeth, expressed by the Weighted Kappa statistic[32] and 95% Confidence Interval (CI).

Operator	*Intra-operator variability*		*Inter-operator variability*	
	Weighted Kappa statistic	**95% CI**	**Mean Weighted Kappa statistic***	**95% CI**
1	1.0	0.0 – 0.0	0.79	0.59 – 0.98
2	0.93	0.78 – 1.0	0.70	0.45 – 0.93
3	0.82	0.61 - 1.0	0.75	0.53 – 0.96
4	0.93	0.79 – 1.0	0.72	0.51 – 0.94
5	0.96	0.90 - 1.0	0.74	0.51 – 0.95
Overall	**0.94**	**0.73 – 1.0**	**0.84**	**0.75 – 0.94**

* Mean of Weighted Kappa statistic for comparisons of that operator with each of the remaining four operators.

Statistical analysis

Intra- and inter-operator variability were analyzed using the Weighted Kappa statistic.[32]

Data such as subjects' personal histories and clinical and radiographic scores for the first and second permanent molar teeth, were analyzed using the statistical software package SPSS-PC || Version 10.0. Pearson's chi-square test, the Student's *t*-test, and the *t*-test on natural log were used to determine statistical differences between groups with respect to both subjects and teeth. The alpha value was placed at 0.05.

|| SPSS Inc (2000). Headquarters, 233 S. Wacker Drive, 11th floor, Chicago, Illinois 60606

Results

Characteristics of study population (Table 5)

A total of 2148 permanent first and second molars were examined in 481 subjects. Two hundred and nineteen teeth (10%) were excluded on the basis of clinical or radiographic criteria, leaving a total of 1929 teeth for inclusion in the study. Of these, 1683 (87%) were permanent first molars (863 mandibular and 820 maxillary), and 246 (13%) were permanent second molars (140 mandibular and 106 maxillary).

Details of the 481 subjects studied are shown in Table 5. The proportion of males (55%) and females (45%) were approximately equal. The mean age ± standard deviation (SD) at the time of examination was 8.1 ± 2.2 years (range 5 to 12 years).

Of the 481 subjects, 118 (25%) had at least one medical condition. The most commonly reported was asthma (54.2%), followed by allergies (20.3%), cardiovascular conditions (6.1%) and other, unspecified conditions (3.3%). There were 16.1% of subjects with two or more medical conditions.

Despite the lack of fluoride in Brisbane's water supply, only 21% of subjects had a positive history of fluoride supplementation. The majority (n= 410, 85%) of subjects were born in non-fluoridated areas, and the mean age at which fluoride toothpaste use begun (± standard deviation) was 22.3 ± 13.7 months (range 4 to 84 months).

Table 5. Characteristics of subjects with and without occlusal dentine radiolucencies in teeth clinically scored as sound.

	Occlusal dentine radiolucency in a tooth clinically scored as sound			
SUBJECTS	**PRESENT N(%)**	**ABSENT N(%)**	**TOTAL N(%)**	***P*-value**
Total Number	48 (10%)	433 (90%)	481(100%)	
Gender				
Male	28 (58%)	237 (55%)	265(55%)	NS
Female	20 (42%)	196 (45%)	216(45%)	*P*>0.1
Age at examination				
Mean (yrs ± SD)	8.7 ± 2.0	8.0 ± 2.2	8.1 ± 2.2	NS
Range	5 - 12	6 - 12	5 - 12	*P*>0.1
Medical Condition				
No	38 (79%)	325 (75%)	363(75%)	
Asthma	5 (50%)	59 (54.6%)	64(54.2%)	
CVS condition	0 (0%)	7 (6.5%)	7(6.1%)	
Epilepsy	0 (0%)	0 (0%)	0(0%)	
Allergies	5 (50%)	19 (17.6%)	24(20.3%)	
Syndrome	0 (0%)	0 (0%)	0(0%)	
Others	0 (0%)	4 (3.7%)	4(3.3%)	
Two or more of the above conditions	0 (0%)	19 (17.6%)	19(16.1%)	
Total (%) with medical condition	10 (21%)	108 (25%)	118(25%)	NS *P*>0.1
Fluoride supplementation				
Yes	12 (25%)	87 (20%)	99(21%)	NS
No	36 (75%)	346 (80%)	382(79%)	*P*>0.1
Commencement of fluoride toothpaste use				
Mean (months ± SD)	21.0 ± 7.9	22.3 ± 14.0	22.3 ± 13.7	NS
Range	6 - 36	4 - 84	4 - 84	*P*>0.1
Fluoridation of birthplace				
Yes	10 (21%)	61 (14%)	71(15%)	NS
No	38 (79%)	372 (86%)	410(85%)	*P*>0.1
Sealant longevity				
Mean (months ± SD)	19.9 ±14.5	19.8 ± 15.3	19.8 ± 15.1	NS
Range	3.2 – 51.1	1.2 – 81.2	1.2 – 81.2	*P*>0.1

Among fissure sealed teeth, the mean sealant longevity at the time of examination (± standard deviation) was 19.8 ± 15.1 months (range 1.2 to 81.2 months).

<u>Correlation of clinical and radiographic assessments</u> (Table 6)

(i) Overall prevalence of clinical and radiographic scores

The individual results of clinical assessment of the 1929 teeth were correlated against the results of radiographic assessment and are shown in Table 6. Of the 1929 teeth examined, 1491 (77.3%) were unsealed and 438 (22.7%) were fissure sealed.

Out of 1929 teeth, 1833 (95%) were scored as clinically sound. Of these, 77% were scored as non-carious (enamel or dentine), 11.8% were scored as fissure discolouration, 8.1% were scored as fissure enamel demineralization, 2.9% were scored as fissure discolouration and demineralization, 14.0% were scored as non-carious, intact sealant, and 9.5% were scored as non-carious, partially retained sealant. Of the remaining 96 (5%) teeth, 58.3% were clinically scored as early dentine caries, 34.4% were scored as frank dentine caries, and 7.3% were scored as dentine caries in direct association with a partially retained sealant.

Radiographically, 1801 (93.4%) teeth did not exhibit a radiolucency in dentine immediately beneath the occlusal surface, whereas 104 (5.4%) teeth had a distinct radiolucency in the outer one-third of dentine beneath the occlusal

Table 6. Cross tabulation of clinical and radiographic scores for the occlusal surfaces of all first and second permanent molar teeth showing actual numbers (n) and percentages (%) of teeth.

	Clinical score n (%)									
	Fissure score*						**Sealant score†**			
Radiographic score‡ n (%)	**C0**	**C1**	**C2**	**C3**	**C4**	**C5**	**F0**	**F1**	**F2**	***Row Total n (%)***
R0	961 49.8% §	207 10.7%	146 7.6%	50 2.6%	40 2.1%	0 0.0%	240 12.4%	157 8.1%	0 0%	**1801 93.4%**
R1	20 1.0%	9 0.5%	3 0.2%	3 0.2%	14 0.7%	19 1.0%	14 0.7%	16 0.8%	6 0.3%	**104 5.4%**
R2	3 0.2%	0 0%	0 0%	0 0%	1 0.1%	9 0.5%	3 0.2%	1 0.1%	1 0.1%	**18 0.9%**
R3	0 0%	0 0%	0 0%	0 0%	1 0.1%	5 0.3%	0 0%	0 0%	0 0%	**6 0.3%**
Column Total n (%)	**984 51%**	**216 11.2%**	**149 7.7%**	**53 2.8%**	**56 2.9%**	**33 1.7%**	**257 13.3%**	**174 9.0%**	**7 0.4%**	**1929 100%**

*Table1
†Table 2
‡Table 3
§Percentage of total

surface, 18 (0.9%) had a radiolucency extending to two-thirds the thickness of occlusal dentine, and 6 (0.3%) had a radiolucency extending the full thickness of occlusal dentine. The most frequent diagnosis was therefore the combination of a clinically sound occlusal surface and absence of an occlusal dentine radiolucency [961 teeth (49.8%)].

Of the 438 fissure sealed teeth, 257 (58.7%) were judged as non carious, clinically intact, 174 (39.7%) were judged as non carious, partially retained, and 7 (1.6%) had dentine caries in direct association with a partially retained sealant (i.e. carious, partially retained sealant). Of sealed teeth, the most frequent diagnosis was a combination of a clinically intact sealant and absence of an occlusal dentine radiolucency beneath the sealant surface [240 teeth (54.8%)].

(ii) Prevalence of dentine radiolucencies beneath clinically sound occlusal surfaces (Table 7)

Subject prevalence

As shown in Table 7, there were 48 subjects with at least one tooth with a dentine radiolucency beneath a clinically sound occlusal surface, giving an overall subject prevalence of 10% (95% CI:7.5% – 12.9%). There was no gender difference (males 10.6% vs females 9.3%, $P>0.1$).

Tooth prevalence

By comparison, of the 1929 teeth examined, only 72 exhibited a dentine radiolucency beneath a clinically sound occlusal surface, giving an overall tooth prevalence of 3.7% (Table 7). There was no gender difference in tooth prevalence (males 4.2% vs females 3.1%, $P>0.1$).

Table 7. General prevalence of occlusal dentine radiolucencies in first and second permanent molar teeth clinically scored as sound.

	Female	**Male**	**Total**
Prevalence by subjects			
Population	*N*=216	*N*=265	*N*=481
No. with at least one lesion	20	28	48
Percentage affected	9.3%	10.6%	10.0%
Prevalence by teeth			
No. of teeth examined	*N*=892	*N*=1037	1929
No. of teeth affected	28	44	72
Percentage affected	3.1%	4.2%	3.7%

<u>Comparison of demographic variables between groups with and without dentine radiolucencies beneath clinically sound occlusal surfaces</u> (Table 5)

To explain why a dentine radiolucency appears beneath a clinically sound occlusal surface, a number of variables were investigated among subjects with the lesion and those without the lesion. Among all the variables shown in Table 5, there were no statistically significant differences between the group with dentine radiolucencies beneath clinically sound occlusal surfaces, and those without dentine radiolucencies (P>0.1). Of interest is that there was no association between dentine radiolucencies beneath clinically sound occlusal surfaces and fluoride exposure, such as the commencement of fluoride toothpaste use and toothbrushing, fluoride supplements, and water fluoridation.

<u>Comparison of prevalence of dentine radiolucencies beneath clinically sound occlusal surfaces, by sealed and unsealed teeth, and tooth type</u> (Table 8)

The prevalence of dentine radiolucencies beneath clinically sound occlusal surfaces in unsealed and sealed first and second permanent molar teeth was compared (Table 8). The three times higher prevalence of lesions among sealed molars (n=34, 7.8%) compared with unsealed molars (n=38, 2.5%) was statistically significant (P<0.001). This difference was significant across first molars only, due to the relatively small number of sealed second molar teeth (n=10). There was no significant difference in the prevalence of lesions

Table 8. Comparison of prevalence of occlusal dentine radiolucencies in teeth clinically scored as sound.

Occlusal dentine radiolucencies in teeth clinically scored as sound n (%)						
	Unsealed Molars (N=1491)	**Sealed molars (N=438)**			**Total (N=1929)**	***P*-value** *(unsealed vs sealed molars)*
		Sealant intact (N=248)	Sealant partially retained (N=181)	All sealed molars (N=438)		
1st Molars (N=1683)	35 (2.8%)	16 (6.5%)	NS 16 (8.9%)	32 (7.5%)	67 (4.0%)	$P<0.001$ $x^2=18.35$ df=1
2nd Molars (N=246)	3 (1.3%)	1 (11.1%)	NS 1 (100%)	2 (20.0%)	5 (2.0%)	NS $P>0.1$
Total (N=1929)	38 (2.5%)	17 (6.9%)	NS 17 (9.4%)	34 (7.8%)	72 (3.7%)	$P<0.001$ $x^2=26.63$ df=1
***P*-value** *(first vs second molars)*	NS $P>0.1$					

NS Non significant comparison ($P>0.1$)

between intact sealants and partially retained sealants across all tooth types (first molars, second molars, total) ($P>0.1$) (Table 8).

There was no significant difference in the prevalence of dentine radiolucencies beneath occlusal surfaces clinically scored as sound among first molars compared to second molars across all categories of teeth (unsealed, sealed, total) ($P>0.1$, Table 8). Likewise, there was no significant difference in prevalence among mandibular compared with maxillary molars ($P>0.1$) (data not presented).

Comparison of bitewing radiolucencies in teeth clinically scored as sound and in teeth scored as dentine caries (Table 9)

The 1929 teeth in the study were divided into two groups, those with a radiolucency in occlusal dentine on a bitewing radiograph, and those without a radiolucency (Table 9). For both of these groups, the distribution of teeth across both unsealed and sealed molars was examined on the basis of whether the occlusal surface had been clinically scored as either dentine caries (Fissure scores C4, C5, Table 1 and Sealant score F2, Table 2) or scored as sound.

As shown in Table 9, when a bitewing radiolucency was present in an unsealed molar, the tooth was not significantly more likely to be scored clinically as dentine caries than scored as sound ($P>0.1$). In the case of sealed molars however, when a bitewing radiolucency was present, the occlusal surface was significantly more likely to be scored as sound than scored as dentine caries ($P<0.001$). Combining sealed and unsealed teeth, the percentage of dentine

Table 9. Comparison of occlusal dentine radiolucencies in unsealed and sealed permanent molars clinically scored as sound and in teeth scored as dentine caries.*

	Radiolucency in occlusal dentine on bitewing radiograph n (%)					
	PRESENT			**ABSENT**		
	Teeth clinically scored as dentine caries	Teeth clinically scored as sound	***P*-value** *(carious vs sound)*	Teeth clinically scored as dentine caries	Teeth clinically scored as sound	***P*-value** *(carious vs sound)*
Unsealed molars (N=1491)	49 3.3%	38 2.5%	NS $P>0.1$	40 2.7%	1364 92.0%	$P<0.001$ $x^2=2386.61$ df=1
Sealed molars (N=438)	7 1.6%	34 7.8%	$P<0.001$ $x^2=18.65$ df=1	0 0%	397 91.0%	$P<0.001$ $x^2=732.8$ df=1
Total (N=1929)	56 2.9%	72 3.7%	NS $P>0.1$	40 2.1%	1761 70.0%	$P<0.001$ $x^2=1926.4$ df=1
***P*-value** *(sealed vs unsealed molars)*	NS $P=0.06$	$P<0.001$ $x^2=26.63$ df=1		$P<0.001$ $x^2=12.0$ df=1	NS $P>0.1$	

*Fissure scores C4, C5, Table 1 and Sealant score F2, Table 2.

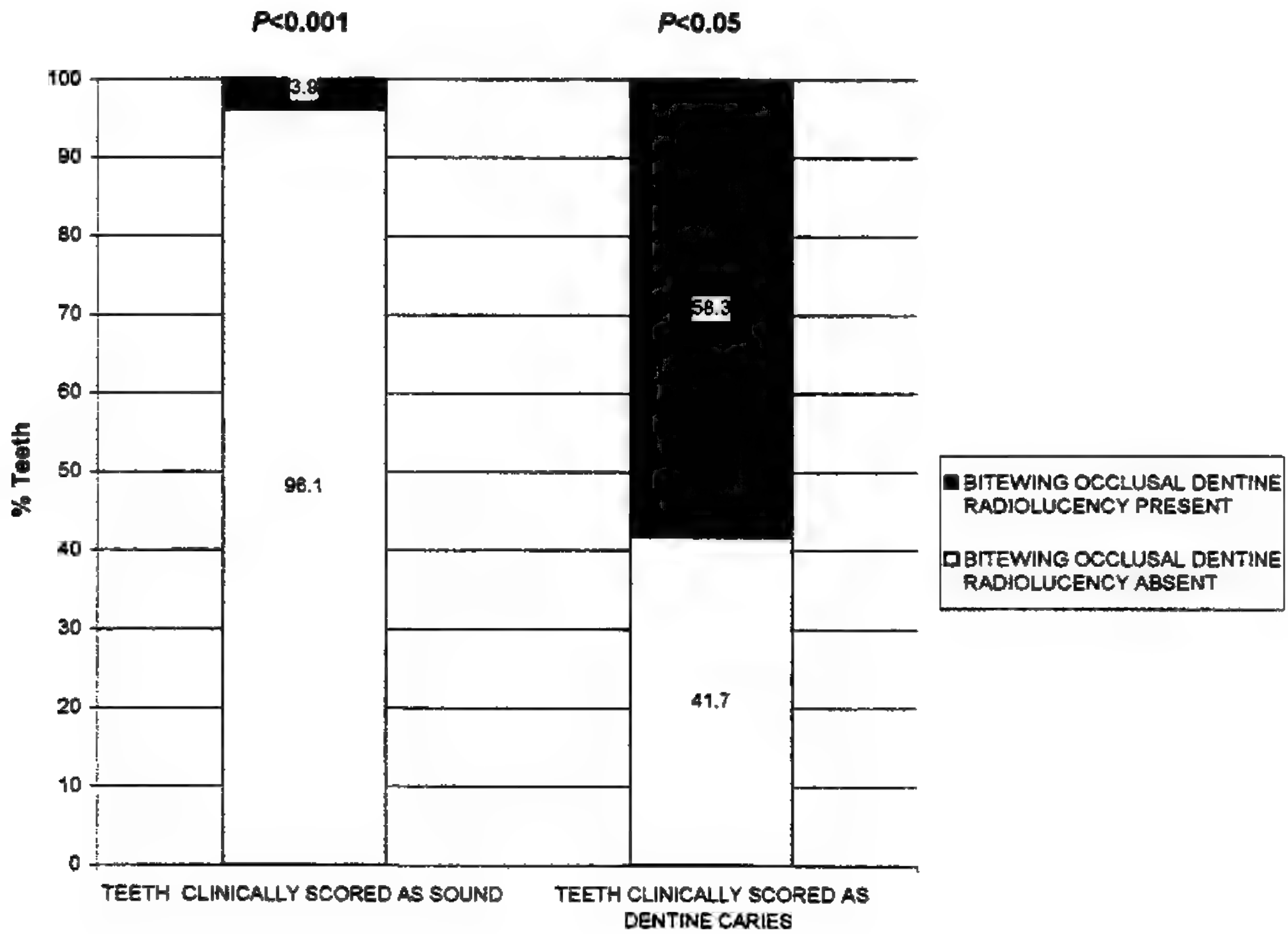
radiolucencies in molars clinically scored as sound and clinically scored as dentine caries was not significantly different ($P>0.1$). When a bitewing radiolucency was present in a molar clinically scored as sound, the tooth was significantly more likely to have been sealed than unsealed ($P<0.001$).

As shown in Table 9, when a bitewing radiolucency was absent in an unsealed molar, the tooth was significantly more likely to be scored clinically as sound than scored as dentine caries ($P<0.001$). Similarly, among sealed molars in the absence of a bitewing radiolucency, significantly more teeth were scored clinically as sound than scored as dentine caries ($P<0.001$). Overall, significantly more teeth were scored clinically as sound than were scored as dentine caries in the absence of a bitewing radiolucency ($P<0.001$) (Table 9). The few teeth scored clinically as dentine caries but without a bitewing radiolucency were among unsealed molars (n=40, 2.7%).

Comparison of the radiographic appearance of all teeth clinically scored as sound and clinically scored as dentine caries (Figure 1)

As shown in Figure 1, when a tooth was clinically scored as sound, the likelihood of a dentine radiolucency being absent on a bitewing radiograph was significantly greater than the likelihood of a dentine radiolucency being present ($P<0.001$). Conversely, when a tooth was clinically scored as dentine caries, there was a significantly greater chance of a dentine radiolucency being present on a bitewing radiograph than there not being a dentine radiolucency ($P<0.05$). Of interest was that 42% of teeth clinically scored as dentine caries did not present with a dentine radiolucency on a bitewing radiograph (Fig. 1).

Figure 1. Comparison of the radiographic appearance of all teeth clinically scored as sound and clinically scored as dentine caries.



Discussion

The observation that a number of radiographic occlusal dentine lesions escape clinical detection,[4-12] together with the fact that occlusal caries contributes the majority of all new carious lesions in children and adolescents,[1-3] question the appropriateness of current clinical methods in the diagnosis of occlusal caries in this age group. In our prospective study of 1929 unsealed and sealed first and second permanent molar teeth in 481 primary-school children, it was found that 10% of subjects had at least one tooth with a dentine radiolucency beneath an occlusal surface clinically scored as sound. The overall tooth prevalence of 3.7% found in this study is a modest figure compared to the relatively high prevalences reported in a few studies.[6,9-11] Considering only unsealed molars, our results indicate a similar prevalence to that reported by Sawle and Andlaw, who found a tooth prevalence of 3.1 to 3.6% among unsealed first and second permanent molars.[7]

An interesting finding from the present study is that a clinical examination under near ideal conditions, and using certain visual-tactile characteristics, can usually predict the presence or absence of a dentine radiolucency on a bitewing radiograph. Among teeth clinically scored as sound with respect to the occlusal surface, only 4% presented with a dentine radiolucency on a bitewing radiograph. Thus, in the majority (96%) of teeth clinically scored as sound a radiograph confirmed the absence of an occlusal dentine radiolucency. When an occlusal surface was clinically scored as dentine caries, more than half were found to have a radiographic dentine lesion. The finding that 42% of teeth clinically scored

as dentine caries did not demonstrate a dentine radiolucency, is a likely reflection of two factors. The first relates to the fact that probing for stickiness using an explorer (fissure score C4, Table 1) is not specific to dental caries, and may reflect other variables, such as probing pressure, the path of insertion and withdrawal of the explorer, the width of the explorer tip, and fissure anatomy.[19] Thus probes may "stick" in many sound but deep fissures. The second is that early occlusal dentine lesions (fissure score C4, Table 1) do not always appear as distinct dentine radiolucencies on bitewing radiographs,[28,31] due to their relatively less demineralized state in comparison with more established lesions. Our findings, nonetheless, provide convincing evidence of the appropriateness of a current clinical method in the diagnosis of radiographic occlusal dentine lesions in children, based on a prospective, clinical examination of occlusal surfaces under standardized conditions.

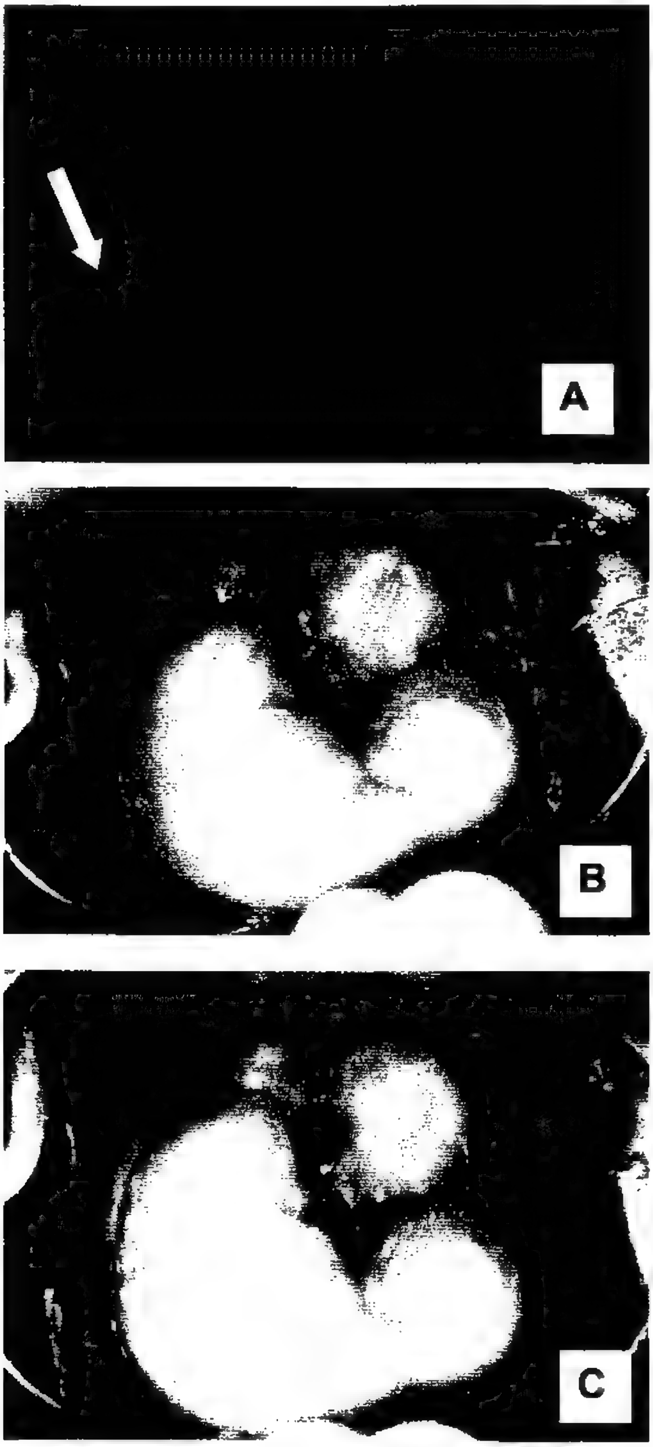
The nature of dentine radiolucencies beneath clinically sound occlusal surfaces has received much speculation. Our results suggest that systemic factors probably play a minimal role in the etiology of this lesion, in as much as there were no significant gender or age differences, or differences in the prevalence of various medical conditions between the group with and without the lesion.

Of interest is our finding that fluoride exposure in the form of fluoride supplements, fluoride toothpaste and water fluoridation was also not significantly associated with dentine radiolucencies in teeth clinically scored as sound. Fluoride has provided a popular explanation for how a dentine radiolucency may

have arisen beneath a clinically sound occlusal surface. The development of this lesion seemed to cohere with our current understanding of the mechanism of action of fluoride, in decreasing enamel solubility and promoting remineralization of the pit and fissure enamel. It has been suggested that due to the effects of fluoride, caries could progress into dentine without any changes in the integrity of the overlying occlusal enamel.[13,14,33,34] Our results, however, do not support this theory, in that children who showed dentine radiolucencies beneath clinically sound occlusal surfaces did not have more exposure to fluoride compared to those who did not have the lesion. Similar findings had been reported by Weerheijm et al,[35] in their study comparing the prevalence of occult lesions in a fluoridated and non-fluoridated town.

Recent observations as part of a study by Seow et al[36] support the novel concept that some dentine radiolucencies beneath clinically sound occlusal surfaces may have actually originated as pre-eruptive intracoronal dentine radiolucencies. This finding establishes for the first time in the literature that in a certain percentage of children, such dentine radiolucencies are not in fact caries but rather, resorptive lesions which were initiated during the pre-eruptive stages.[37-39] It is highly likely that pre-eruptive intra-coronal dentine radiolucencies become secondarily infected by cariogenic bacteria once the tooth erupts, so that they become clinically indistinguishable from caries. Others may erupt with a completely intact occlusal surface, giving an appearance similar to that shown in Fig. 2.

Figure 2. Occlusal dentine radiolucency on a bitewing radiograph (A, *arrow*) of a mandibular first permanent molar clinically scored as sound (B), and clinical appearance of the tooth at operative access (C).



In the present study, of clinical significance is the finding that dentine radiolucencies beneath clinically sound occlusal surfaces were three times more commonly associated with sealed molars compared with unsealed molars. Why sealed molars had a significantly higher prevalence of dentine radiolucencies beneath clinically sound occlusal surfaces compared to unsealed molars, may be explained on the basis of two factors. The first relates to the visual obscuring effect of the sealant so that it prevented accurate assessment of the occlusal surface, and only the sealant was scored, not the true occlusal surface. Secondly, during the placement of sealants, no radiographs were available to identify dentine radiolucencies, so it is likely that dentine lesions were present prior to sealants being placed. Despite the fact that anything more than the expected attrition of a sealant occurring over time due to tooth wear renders a tooth with the same caries susceptibility as a non-sealed surface,[40] the prevalence of radiographic dentine lesions beneath clinically sound occlusal surfaces among partially retained sealants (Fig. 3) was not significantly different from that in clinically intact sealants (Fig. 4). If the lesions were not present prior to sealing then we would have expected a significantly greater prevalence of dentine lesions among partially retained, defective sealants. The finding that mean sealant longevity was approximately twenty months (range 1.2 to 81.2 months) further supports the pre-existence of radiographic dentine lesions in relation to sealant placement, as this provided sufficient opportunity for caries to initiate beneath defective sealants. It is therefore more plausible that the role of defective sealants in our study may have been in contributing to further

Figure 3. Occlusal dentine radiolucency on a bitewing radiograph (A, *arrow*) of a non-carious, partially sealed mandibular first permanent molar (B).

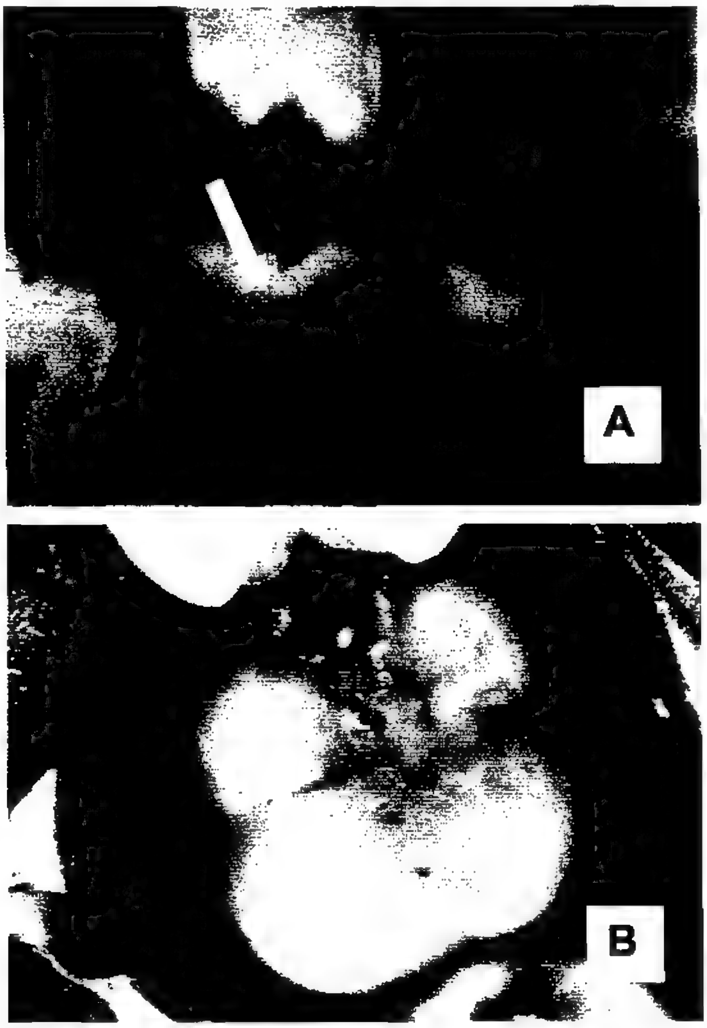
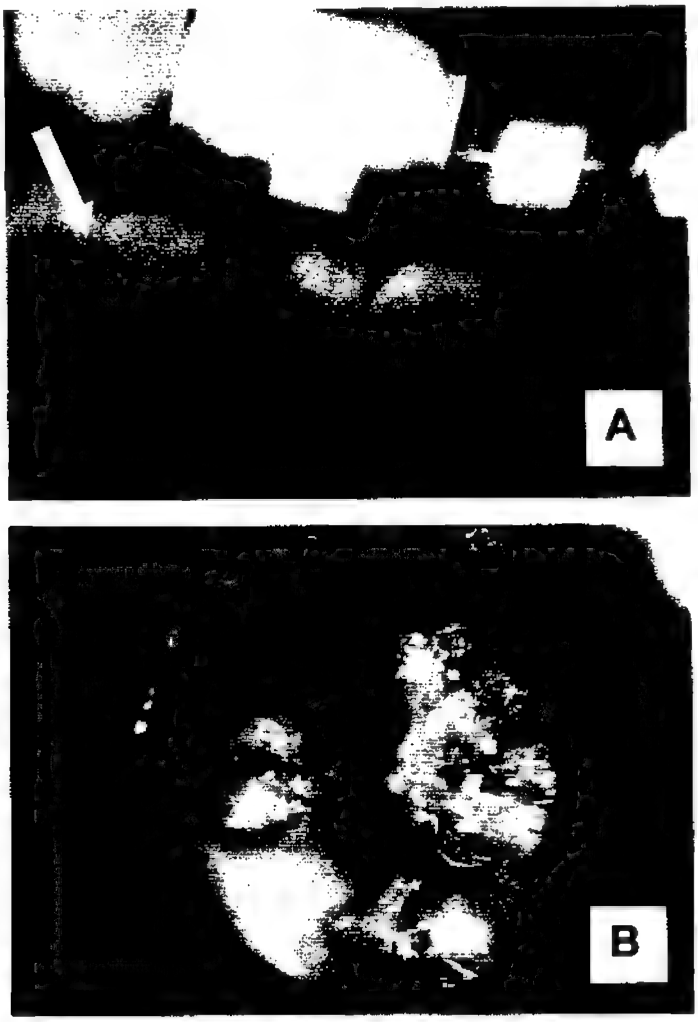


Figure 4. Occlusal dentine radiolucency on a bitewing radiograph (A, *arrow*) of a clinically intact sealed mandibular second permanent molar (B).



progression of a pre-existing lesion beneath the partially sealed surface, rather than having caused a dentine lesion to develop *per se*.

Further establishing that dentine radiolucencies beneath clinically sound occlusal surfaces probably occurred among sealed teeth in a manner unrelated to sealant failure, is that lesions were also observed beneath clinically intact sealants (Fig. 3). Most evidence suggests that sealing early enamel or early dentine lesions will arrest the progression of caries provided the sealant remains intact.[41] Thus the most plausible explanation for the occurrence of radiographic occlusal dentine lesions beneath clinically intact sealants in our study, is that they were present but not identified prior to sealant placement because radiographs were not taken, rather than having developed subsequently. Unfortunately, among all cases of dentine radiolucenies beneath clinically sound occlusal surfaces, few pre-operative radiographs were available to confirm this. In this regard, concern about the quality of caries diagnosis before sealant application has been expressed by Weerheijm et al,[12] who found a higher proportion of occlusal dentine radiolucencies associated with sealed teeth in 1993 compared to 1987.

A final explanation for the occurrence of dentine radiolucencies beneath clinically sound occlusal surfaces relates specifically to the clinical criteria used in the examination of teeth. The wide range in prevalence of these dentine radiolucencies among previous studies may be accounted for, in part, by the failure to employ the appropriate clinical criteria, particularly the definition of "sound". It is known that a clinical examination under ideal conditions (good

lighting, teeth that are clean and dry, and the use of magnification lenses) using criteria which include non-cavitated diagnoses, more readily identifies radiographic dentine lesions[21,22,29,30] than a system which focuses on the presence or absence of a cavity. For example, one study found the prevalence of dentine radiolucencies beneath clinically sound occlusal surfaces to have more than doubled when using only the cavitated level of clinical diagnosis.[5] In the present study, the use of the term sound was avoided in the clinical examination of teeth, and applied only after data collection. The unique feature of the clinical criteria[30,31] applied in this study is that it emphasized the visual appearance of the occlusal surface, rather than simply relying on the operator to make a judgement as to whether the surface was carious or sound. This decision itself relates to the operator's personal beliefs as to what requires restoration and what does not. Therefore, had our clinical criteria not reflected a more objective assessment than has been used in previous studies,[4,5,7,8,10,11] the prevalence of dentine radiolucencies beneath clinically sound occlusal surfaces is likely to have been considerably higher.

Regarding the management of radiographic dentine lesions beneath clinically sound occlusal surfaces, there appears to be a consensus opinion that once an occlusal lesion is visible radiographically it should be restored[15,16] with either adhesive materials such as glass ionomer cements and composite resins or amalgam. It is likely that once an occlusal lesion is visible on a radiograph, the demineralization has already extended to at least the middle third of dentine, and there is also a significant rise in the number of recoverable bacteria in the dentine

when a lesion is radiographically visible compared to one that is not.[42] Whilst studies of the efficacy of ultraconservative, so-called "cariostatic" restorations in the management of occlusal caries has recently received much attention, sealing over radiographic dentine lesions where the occlusal surface appears clinically sound, is probably a more dubious decision. Should the sealant fail, the dentine lesion already has a "head start", and there are inherent problems associated with radiographic monitoring of dentine radiolucencies.[15] Frequent monitoring of the clinical integrity of the sealant is equally challenging.

Conclusions

1. The prevalence of dentine radiolucencies beneath clinically sound occlusal surfaces in first and second permanent molar teeth among children was 10% by subjects and 3.7% by teeth examined. The prevalence was significantly higher among fissure-sealed molars (7.8%) compared with unsealed molars (2.5%) ($P<0.001$). Dentine radiolucencies beneath clinically sound occlusal surfaces were not significantly associated with age, gender, medical conditions, fluoride exposure and sealant integrity ($P>0.1$). The presence or absence of a dentine radiolucency on a bitewing radiograph was significantly associated with the clinical scoring of the occlusal surface with respect to caries status ($P<0.05$).
2. A clinical examination of clean, dry, and well-illuminated teeth based on visual-tactile characteristics can usually predict the presence or absence of a dentine radiolucency on a bitewing radiograph. In 3.7% of teeth the occurrence of a dentine lesion on a radiograph is not readily identifiable from a clinical examination alone.

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LIST OF TABLES

LIST OF FIGURES

APPENDIX I

Research Ethics Committee approval and parental/guardian examination consent forms

THE UNIVERSITY OF QUEENSLAND

Institutional Approval Form For Experiments On Humans Including Behavioural Research

Chief Investigator	Matthew Fracaro
Department	Dentistry
Other Investigator(s) /Supervisor	A/Prof W Kim Seow, Dr L H McAllan
Department2	Dentistry
Project title	Prevalence Of Occult Caries In Permanent First And Second Molars
Project Number	**D/22/Dent/98/M**
Duration	
Granting agency or degree enrolled:	Master of Dental Science

Comments:

Name of responsible Ethics Committee:

Dental Sciences Human Ethics Committee

This project complies with the provisions contained in the Council's document 'Statement on Human Experimentation and Supplementary Notes' and complies with the regulations governing experimentation on humans within your institution.

Name of Ethics Committee representative:
Assoc. Prof. Neil Savage
Dept. of Dentistry
Chair, Dental Sciences Human Ethics Committee

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02 FEB 1999

OFFICE OF RESEARCH
AND POSTGRADUATE STUDIES

Signature N W Savage **Date** 2-02-99

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CUMBRAE-STEWART BUILDING
RESEARCH ROAD
Tel: (07) 3365 4582
Fax: (07) 3365 4455
Email: l.martin@.research.uq.edu.au

THE UNIVERSITY OF QUEENSLAND

Brisbane Qld 4072 Australia
Telephone (07) 3365 3560, 3365 4584
International +61 7 3365 3560, 3365 4584
Facsimile (07) 3365 4455

3/02/99

Matthew Fracaro

Dentistry

Dear Matthew Fracaro

Concerning:-Ethical Clearance for project

Project Title **Prevalence Of Occult Caries In Permanent First And Second Molars**

Project Number D/22/Dent/98/M

Your project has been approved by the Dental Sciences Human Ethics Committee.

Please note that:-

(I) The Clearance number should be quoted on the protocol coversheet when applying to a granting agency and in any correspondence relating to ethical clearance;

(ii) Clearance will normally be for the duration of the project unless otherwise stated in the institutional clearance:

(iii) Adverse reaction to treatment by subjects, injury or any other incident affecting the welfare and/or health of subjects attributable to the research should be promptly reported to the Head of Department and the Dental Sciences Human Ethics Committee.

(iv) Advisers on 'Integrity in Research'
As part of the University's commitment to the institutional statement, "Code of Conduct for the Ethical Practice of Research" (1990), and the NH&MRC's "Statement on Scientific Practice", designated positions have been appointed as advisers on integrity in research. The Chairperson of each ethics committee acts in an advisory capacity to provide confidential advice on such matters as misconduct in research, the rights and duties of postgraduate supervisors, and procedures for dealing with allegations on research misconduct within the University. The contact number for the Chairperson of each ethics committee can be obtained from the Ethics Officer.

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Page 2 **D/22/Dent/98/M**

(v) The Committee reserves the right to visit the research site and materials at any time during the project.

(vi) It is the Committees expectation whenever possible, this work should result in publication and the Committee would require details to be submitted for our records.

Staff and students are also encouraged to contact either the Ethics Officer (3365 3924), or Chairperson on other issues concerning the conduct of experimentation/research (e.g. involvement of children, informed consent) prior to commencement of the project and throughout the course of the study.

Yours sincerely

Lynne Martin
Ethics Officer
Office of Research and Post-Graduate Studies

encs.
cc: file

A/Prof W Kim Seow, Dr L H McAllan

Dentistry

QUEENSLAND HEALTH

Oral Health Education Unit
150 Park Road
YERONGA Q 4104
Ph: 3249 1145
Fax: 3892 2933

PARENTAL CONSENT FORM

PLEASE COMPLETE ALL CHILD/STUDENT'S DETAILS AND RETURN TO THE SCHOOL OR SCHOOL DENTAL CLINIC.

CHILD/STUDENT: LAST NAME: ______________________

FIRST NAMES: ______________________

DATE OF BIRTH: ____________ GENDER: ____ (F = Female; M = Male)

ADDRESS: No. & STREET: ______________________

SUBURB: ______________ POST CODE: ________

CONTACT NAME: ______________ (Parent/Guardian)

TELEPHONE: ( ) ______________ (Home) ( ) ______________ (Work)

NAME OF SCHOOL OR PRE-SCHOOL: ______________ CLASS: ________

Has your child/student had previous Dental Treatment at a School Dental Clinic or a Mobile Dental Van in Queensland? Yes ☐ No ☐ If YES, what year? ________

What school was your child/student attending when last treated? ________

What language is spoken at home? ________

CONSENT TO TREATMENT (for a minor)

PLEASE TICK ONE BOX ONLY

☐ I CONSENT

that my child ______________________ (Child's Name in Full)

☐ I DO NOT CONSENT

receives a dental examination AND UNDERSTAND THAT

- dental X-rays may be taken as part of the examination, and
- preventive procedures such as oral hygiene assistance, cleaning of teeth, and the application of fluoride to the teeth may also take place at that appointment.
- treatment may be undertaken by students under direct supervision.

SIGNED: ______________________ (Parent/Guardian) DATE: ___/___/___

IF ANY OTHER TREATMENT IS RECOMMENDED, YOU WILL BE ASKED TO CONTACT THE CENTRE FOR FURTHER CONSENT

CONSENT TO RELEASE FROM SCHOOL

I understand that return bus transport is available between my child's school and the Oral Health Education Uni during school hours.

PLEASE TICK ONE BOX ONLY

☐ I agree that my child be released from school and transported to and from the Centre by bus.

☐ I prefer to arrange transport for my child. I will contact the centre to make an appointment.

SIGNED: ______________ (Parent or Guardian) NAME: ______________ (Please Print) DATE: ___/___/___

PLEASE TURN OVER AND COMPLETE MEDICAL/DENTAL HISTORY

CHILD/STUDENT'S MEDICAL/DENTAL HISTORY

It is important to know of any concerns that your child/student is having with his/her teeth or mouth. It is als important to know details on your child/student's medical or dental history that could affect the success of ou health care (dental treatment).

PLEASE DESCRIBE ANY CONCERNS ABOUT YOUR CHILD/STUDENT'S TEETH OR MOUTH.

. . . .

. . . .

** PLEASE TICK (✓) EITHER THE YES OR NO BOX AGAINST <u>EVERY</u> QUESTION.

Has your child/student had a history of the following?

YES	NO		YES	NO	
☐	☐	Asthma	☐	☐	Allergic Reaction to any substance
☐	☐	Heart Problems	☐	☐	Abnormal Reaction to a Medicine/Drug
☐	☐	Rheumatic Fever	☐	☐	Abnormal Reaction to Local Anaesthetic
☐	☐	High/Low Blood Pressure	☐	☐	Abnormal Reaction to General Anaesthetic
☐	☐	Blood Disease	☐	☐	Abnormal Bleeding after extraction of teeth
☐	☐	Other Lung Disease	☐	☐	Radiation Therapy for Cancer/Tumour
☐	☐	Diabetes	☐	☐	Cortisone Therapy
☐	☐	Hepatitis/Liver Disease	☐	☐	Any Other Abnormal Reaction
☐	☐	Kidney Disease			
☐	☐	Epilepsy			
☐	☐	Any Other Disease/Condition			

Please provide details about any questions marked YES:

____

____

____

CHILD/STUDENT'S DOCTOR'S NAME: ____________________

DOCTOR'S ADDRESS: ____________________

____

DOCTOR'S TELEPHONE: (   ) ____________________

Does your child/student have a current illness? . . . . YES ☐ NO ☐

If Yes, please describe: ____

Has your child/student been seen by a doctor recently? . . . . YES ☐ NO ☐

If Yes, why? ____

Has your child/student been taking any medicine or tablets recently? . . . . YES ☐ NO ☐

If Yes, what is he/she taking? ____

Is your child 'at risk' (or been exposed) to any infectious diseases (eg. HEPATITIS & AIDS)? . . . YES ☐ NO ☐

Do you wish to discuss any medical condition of your child/student confidentially with the dentist? . . . . YES ☐ NO ☐

SIGNED: __________________________________ DATE: ___/___/___

(Parent or Guardian)

APPENDIX II

Clinical and radiographic assessment data collection forms

Section A: Clinical assessment

ID Number

Instructions:

- Complete Patient Register
- Complete patient details in Section A
- Use given clinical criteria to score 1st & 2nd permanent molars ONLY
- Place one score ONLY in appropriate box in Section A ONLY

History fluoride supplements — Yes / No

History fluoride toothpaste use — Age ....months

Place of birth — Country.................................... Town..........................

Medical condition(s):

17	16	26	27
47	46	36	37

Section B: Radiographic assessment

ID Number

17	16	26	27
47	46	36	37

Comments:

Patient (subject) Identification Register

ID Number	School	Grade	Name	DOB	Operator's initials

NOTICE

It would assist staff in providing oral health care for your child if we had the following information about your child.

Please circle the correct answer

- Has your child ever been given fluoride tablets or drops? YES NO
- At what age did your child start using toothpaste? ....years .... months
- Where was your child born? Town ....

  Country ....

CHILD'S NAME ....

CHILD'S SCHOOL .... CHILD'S GRADE ....

Thank you for your help in this matter.

LH McAllan
Director, Oral Health Education Unit

APPENDIX III

Clinical and radiographic assessment criteria

Clinical criteria for occlusal surfaces of first and second permanent molars

Fissure criteria

0	Absence of all below criteria
1	Fissure discolouration only
2	Fissure demineralization only
3	Fissure discolouration + demineralization
4	(i) clinical 'catch' (ii) 'sticky' (iii) visual enamel breakdown in opaque or discoloured enamel ± greyish discolouration from underlying dentine
5	Frank cavitation (i) visually detectable or (ii) probe moves freely within the defect
6	Buccal / lingual / palatal pit or caries + any of **0→5** above
R	Restoration (occlusal or otherwise)
A	Tooth absent
F	Fissure sealed *(→Use criteria for fissure sealants below)*
PE	Tooth partially erupted or accumulation of oral debris/plaque on occlusal surface
H	Hypoplasia or hypomineralization of coronal enamel
X	Any other clinical entity (eg. tooth wear, fractures)

Sealant criteria

F0	No visible loss of occlusal sealant + absence of sealant defect/'catch' detectable with probe
F1	Partial loss of sealant (probe or visible) + no caries (enamel or dentine)
F2	Frank cavitation into occlusal dentine (visible or probe) directly *associated* with **F1**
F3	**F0**, **F1** or **F2** and buccal / lingual / palatal pit or caries

Radiographic criteria for occlusal surfaces of first and second permanent molars

Radiographic criteria	
R0	No radiolucencies in dentine immediately beneath the occlusal surface
R1	Distinct radiolucency in the outer third of dentine immediately beneath the occlusal surface
R2	Distinct radiolucency extending to the middle third of dentine immediately beneath the occlusal surface
R3	Distinct radiolucency extending the full thickness of dentine immediately beneath the occlusal surface
X	Unreadable

APPENDIX IV

Data coding legend and raw clinical data

Data coding legend

idno	Subject identification number
Sex	Male = 1, Female = 2
DOB	date of birth dd/mm/yy
DOE	Date of examination
FlurHX	History of fluoride supplementation: Yes = 1, No = 2
Flurage	Approximate age, in months, the subject commenced fluoride toothpaste use
Birthplace	Subject's place of birth as related to water fluoridation status: Water fluoridation = 1, No water fluoridation = 2
MedHx	No medical condition = 0, asthma = 1, cardiovascular condition = 2, epilepsy = 3, allergies = 4, syndrome = 5, two or more specified conditions = 6, other conditions = 7
Fisdate	Date dd/mm/yy of placement of fissure sealants, where applicable
C17 – C47	Clinical scores for teeth 17 through 47
F17 – F47	Fissure scores for teeth 17 through 47
R17 – R47	Radiographic scores for teeth 17 through 47

Idno	Sex	DOB	DOE	FlurHx	Fluraqe	Birthplace	MedHx	Flsdate	C17	C16	C26	C27	C37	C36	C46	C47	F17	F16	F26	F27	F37	F36	F46	F47	R17	R16	R26	R27	R37	R36	R46	R47
1	2	14/03/93	01/03/99	2	14	2	0		7	7	7	7	7	9	7	7									0	0	0	0	0	0	0	0
2	2	25/02/91	01/03/99	1	16	2	0		7	2	3	7	7	10	10	7									0	0	0	0	2	0	0	2
3	2	09/11/88	01/03/99	1	12	2	0	01/09/98	9	8	8	7	7	8	8	2		1	0			1	0		0	0	0	9	0	0	0	0
4	1	21/10/93	01/03/99	1	9	2	1		7	7	7	7	7	7	7	7									9	9	9	9	9	9	9	9
5	1	14/06/91	01/03/99	2	12	2	1		7	4	12	7	7	12	12	7									9	0	0	9	9	0	9	9
6	1	17/01/91	01/03/99	2	18	1	1		7	0	0	7	7	0	0	7									9	0	2	9	9	0	3	9
7	2	30/03/92	01/03/99	2	30	2	0	01/11/98	7	8	8	7	7	0	0	7	0	0							9	0	0	9	9	0	0	0
9	1	31/12/90	01/03/99	2	12	2	1	01/10/97	7	8	6	7	7	0	0	7		1	1			0	0		9	0	0	9	9	0	0	0
10	2	28/12/91	01/03/99	2	24	2	0		7	9	0	7	7	8	8	7									9	0	0	9	0	0	0	9
11	1	10/12/90	01/03/99	2	36	2	0		7	2	3	7	7	0	0	7									9	0	0	9	9	2	0	0
12	2	29/11/91	01/03/99	2	12	2	0	01/05/98	7	0	8	7	7	0	2	7			1				1		9	0	0	9	9	0	0	9
13	2	29/04/91	01/03/99	1	18	1	0		7	3	0	7	7	0	8	7									9	0	0	9	9	0	0	9
14	2	28/06/91	01/03/99	1	18	2	1	01/08/98	7	6	8	7	7	0	0	7			1			0	0		9	9	0	9	9	0	0	9
15	1	24/12/91	01/03/99	2	18	2	0	01/10/98	7	8	8	7	7	8	8	7		0	0						9	0	0	9	9	9	2	9
16	1	07/01/91	01/03/99	2	12	2	0	01/04/98	7	8	8	7	7	6	3	7		1	1						9	0	0	9	9	0	0	9
17	2	21/09/91	01/03/99	2	12	2	1		7	7	7	7	7	0	0	7									9	0	0	9	9	0	0	9
18	1	17/05/91	01/03/99	2	11	2	0		7	0	2	7	7	2	4	7									9	0	0	9	9	0	0	9
19	1	23/12/90	01/03/99	1	24	2	0		7	0	0	7	7	0	0	7									9	0	0	9	9	0	0	9
20	2	27/12/91	01/03/99	1	12	2	0		7	0	1	7	7	0	0	7									9	0	0	9	9	0	0	9
21	1	13/11/90	01/03/99	2	12	2	4		7	0	0	7	7	0	0	7									9	0	0	9	0	0	0	0
22	1	07/03/91	01/03/99	2	8	2	0		7	0	0	7	7	0	0	7									9	9	0	9	9	0	0	9
23	2	13/07/91	01/03/99	2	12	2	0		7	0	0	7	7	0	0	7									9	0	0	9	0	0	0	0
24	1	26/02/91	01/03/99	2	19	2	1		7	2	0	7	7	0	0	7									9	0	0	9	9	0	0	9
25	1	27/02/89	01/03/99	2	8	1	1	01/04/98	7	6	6	7	7	8	8	7						1	1		9	9	9	9	9	0	0	9
26	1	25/06/92	01/03/99	2	12	2	0		7	2	4	7	7	9	4	7									9	0	0	9	9	0	0	9
27	1	05/09/92	01/03/99	2	38	1	0		7	0	0	7	7	0	0	7									9	0	0	9	9	0	0	9
28	1	08/11/92	01/03/99	2	24	1	7		7	0	1	7	7	0	4	7									9	0	0	9	9	0	0	9
29	1	20/11/90	01/03/99	2	48	2	0	01/04/98	7	0	8	7	7	0	4	7			1						9	0	2	9	9	0	0	9
30	2	17/06/91	01/03/99	2	38	1	0	01/11/98	7	8	8	7	7	8	8	7		0	1			0	0		9	0	0	9	9	0	0	9
31	2	16/04/91	01/03/99	2	12	2	0		7	0	0	7	7	0	0	7									9	0	0	9	9	0	0	9
32	1	04/01/91	01/03/99	1	24	2	0	01/01/98	7	8	8	7	7	8	8	7		0	0			0	0		9	0	0	9	9	2	3	9
33	2	26/10/91	01/03/99	2	24	2	0	01/05/98	7	0	0	7	7	8	8	7						0	0		9	0	0	9	9	0	0	9
34	1	24/12/87	01/03/99	2	12	2	0	01/06/98	4	8	8	7	9	4	1	9		2	1						9	2	0	9	9	2	2	2
35	1	28/06/90	01/03/99	2	48	2	0		7	2	2	7	7	0	0	7									9	0	0	9	9	0	0	9
36	2	10/09/93	01/03/99	2	24	2	0		7	2	2	7	7	0	0	7									9	0	0	9	9	0	0	9
37	2	13/05/92	01/03/99	2	72	2	0		7	0	0	7	7	0	0	7									9	0	0	9	9	0	0	9
38	1	08/12/91	01/03/99	2	12	2	0		7	0	0	7	7	7	0	7									9	0	9	9	9	0	0	9
39	2	02/07/91	01/03/99	2	24	2	0	01/06/98	7	8	8	7	7	8	10	7		1	1			0			9	0	0	9	9	0	0	9
40	2	16/07/92	01/03/99	2	72	2	0		7	2	2	7	7	9	9	7									9	9	0	9	9	0	9	9
41	2	14/06/92	01/03/99	2	84	2	0		7	0	7	7	7	10	9	7									9	0	0	9	9	0	0	9
42	1	22/07/91	01/03/99	1	36	2	0		7	0	0	7	7	0	0	7									9	2	0	9	9	0	2	9
44	1	24/03/92	01/03/99	2	72	2	0		7	10	10	7	7	10	10	7									9	0	0	9	9	0	0	9
46	2	09/09/87	01/03/99	2	24	2	0	01/05/95	6	8	8	8	5	0	0	8	0	0	0	0				0	0	0	0	0	0	0	9	0
47	2	08/07/87	01/03/99	2	24	2	0	01/03/95	4	8	6	4	4	8	6	4		0				0	0		0	2	9	0	0	0	0	2
48	1	03/05/92	01/03/99	2	12	2	0		7	4	7	7	7	9	0	7									9	0	0	9	9	0	0	9
49	1	10/11/89	01/03/99	2	18	1	0		7	0	0	7	7	0	0	7									9	0	0	9	9	0	0	9
50	2	26/06/87	01/03/99	2	18	1	0		7	0	0	7	7	0	0	7									9	0	0	9	9	0	0	9
51	2	24/04/92	01/03/99	2	12	2	0	01/08/98	7	8	8	7	7	8	8	7		0	0			12	0		9	0	0	9	9	0	0	9
52	2	03/03/93	01/03/99	2	12	2	0		7	0	0	7	7	0	0	7									9	0	0	9	9	0	0	0
54	1	07/05/92	01/03/99	2	36	2	0		7	7	7	7	7	9	0	7									9	0	9	9	9	0	0	9
55	2	27/05/92	01/03/99	2	12	2	0		7	3	2	7	7	0	0	7									9	0	0	9	9	0	0	9
56	1	28/04/89	01/03/99	2	38	2	0		7	0	1	7	7	0	0	7									9	0	0	9	0	0	0	0
57	1	02/03/89	01/04/99	2	30	2	0		7	1	1	7	7	0	0	7									0	0	0	9	0	0	0	0
58	2	12/02/87	01/04/99	1	24	1	1	01/05/98	7	8	8	7	1	8	3	1		1	1			1			9	0	0	9	0	0	0	0
59	1	07/11/91	01/04/99	2	12	2	0		7	1	1	7	7	0	0	7									9	0	0	9	9	0	0	9
60	1	20/01/93	01/04/99	2	12	2	0		7	0	0	7	7	0	0	7									9	0	0	9	9	0	0	9
62	1	20/05/92	01/04/99	2	24	2	0		7	0	0	7	7	0	0	7									0	0	0	0	0	2	0	0
63	2	15/10/90	01/04/99	1	6	2	4		7	0	7	7	7	0	0	7									0	2	0	9	0	0	0	0
64	2	15/05/87	01/04/99	2	24	2	0		2	6	8	2	7	6	8	7									0	9	9	0	0	9	9	0
65	1	18/01/93	01/04/99	2	30	2	1		7	7	7	7	7	0	0	7									9	9	9	9	9	0	0	9
66	1	12/02/87	01/04/99	1	32	2	6	01/03/98	7	8	8	7	2	8	8	2		0	0			1	0		9	0	0	9	0	0	0	0
67	2	10/03/90	01/04/99	2	12	2	0		7	2	2	7	7	0	0	7									9	0	0	9	9	0	0	0
69	1	02/12/92	01/04/99	2	24	2	1		7	2	0	7	7	0	0	7									9	0	0	9	9	0	0	0
70	1	17/03/88	01/04/99	2	24	2	7		7	2	0	7	7	12	12	7									9	0	0	9	9	2	2	9
73	1	16/04/88	01/04/99	2	18	2	0	01/03/97	7	4	8	7	7	8	8	7			0			1	1		9	0	0	9	0	0	0	0
74	1	09/09/93	01/04/99	2	12	2	0		7	0	0	7	7	0	0	7									0	0	0	0	0	0	0	0
75	1	14/07/88	01/04/99	2	24	2	0	01/10/97	7	8	6	7	7	6	8	7		0							9	0	9	9	0	9	9	0
76	1	13/06/88	01/04/99	2	24	2	0	01/10/97	7	8	6	7	7	8	8	7		1	0			0	1		9	0	0	9	0	0	0	0
77	1	21/03/88	01/04/99	2	8	2	7		7	0	0	7	7	0	1	7									9	0	0	9	0	0	0	0
78	2	04/06/93	01/04/99	2	24	2	0		7	0	2	7	7	2	0	7									9	0	0	9	9	0	0	9
80	2	26/04/93	01/04/99	2	18	2	1		7	0	0	7	7	2	2	7									9	0	0	9	9	0	0	9
83	1	26/05/92	01/04/99	2	36	2	7	01/06/97	7	8	8	7	7	8	8	7		0	0			0	0		9	0	0	9	0	0	0	0
84	1	15/09/87	01/04/99	2	38	2	7		7	6	8	7	7	0	0	7									9	9	9	9	9	0	0	0
85	2	30/09/92	01/04/99	2	12	2	0		7	2	2	7	7	0	9	7									9	0	0	9	9	0	0	9
86	2	24/02/87	01/04/99	1	12	2	0	01/08/98	1	8	8	1	1	8	8	1		1	1			1	1		0	0	0	0	0	0	0	0
87	1	25/02/92	01/04/99	2	12	1	0		7	0	0	7	7	0	0	7									9	0	0	9	9	0	0	9
88	2	26/08/92	01/04/99	2	38	1	0		7	0	0	7	7	0	0	7									9	0	0	9	9	0	0	9
89	1	04/02/86	01/04/99	2	24	2	1	01/08/98	4	8	8	0	0	0	1	9		0							0	0	9	0	1	0	0	0
91	2	04/01/93	01/04/99	2	24	2	0		7	0	0	7	7	9	0	7									9	0	0	9	9	0	0	9
92	2	02/06/87	01/04/99	2	15	2	0		7	1	1	7	7	0	0	7									0	0	0	0	0	0	0	0
93	2	17/05/91	01/04/99	1	12	2	4		7	9	9	7	7	0	0	7									9	9	9	9	9	0	0	9
94	2	04/11/92	01/04/99	2	18	1	0		7	0	0	7	7	0	0	7									9	0	0	9	9	0	0	9
96	2	07/11/89	01/04/99	2	36	2	0	01/06/98	7	8	8	7	7	8	8	7		0	0						9	0	0	9	9	9	9	0
97	1	28/11/89	01/04/99	2	30	2	1		7	0	1	7	7	0	0	7									9	0	0	9	0	0	0	0
98	2	08/04/89	01/04/99	2	12	2	2	01/05/98	7	8	8	7	7	8	8	7		1	1			1	1		9	0	0	9	9	0	0	9
99	2	09/03/93	01/05/99	2	18	2	1		7	2	2	7	7	0	0	7									9	0	0	9	9	0	0	9
100	2	20/07/93	01/05/99	2	18	2	0		7	7	7	7	7	0	7	7									9	9	9	9	9	0	9	9
101	1	19/03/88	01/05/99	2	12	2	0		7	0	0	7	0	0	0	0									9	2	0	9	0	0	0	0
104	1	24/10/93	01/05/99	2	18	2	0		7	7	7	7	7	0	0	7									9	9	9	9	9	0	0	9
105	1	30/03/88	01/05/99	2	18	2	0	01/06/98	7	8	8	7	7	8	8	7		0	0			2	0		9	2	0	9	0	2	0	0
107	2	14/12/87	01/05/99	2	26	2	0		7	6	4	7	7	5	5	7									0	9	4	0	0	3	4	2
108	1	26/09/88	01/05/99	2	18	2	0	01/08/97	7	8	8	7	7	8	8	7		0	0			0	0		9	2	0	9	9	0	0	9
109	1	20/12/91	01/05/99	2	12	2	0		7	0	0	7	7	0	0	7									9	0	0	9	9	0	0	9
110	2	09/03/87	01/05/99	2	12	2	0	01/05/93	0	6	8	0	2	8	8	2		0	0			0	0		0	0	0	0	0	0	0	0
111	2	11/06/87	01/05/99	2	18	2	0		2	4	3	2	2	6	6	0									0	2	2	0	0	9	9	0
112	2	24/01/93	01/05/99	2	24	2	0		7	0	0	7	7	0	0	7									9	0	0	9	9	0	0	9
113	2	27/03/87	01/05/99	2	38	2	0	01/08/94	0	6	0	1	1	0	0	1		0							0	0	0	0	0	0	0	0

114	2	10/05/91	01/05/99	2	24	2	0		7	0	0	7	7	1	1	7							9	2	0	9	9	0	2	0
115	1	15/03/91	01/05/99	2	24	2	0	01/05/95	7	8	8	7	7	8	0	7	1	0		0			9	0	0	9	9	0	0	9
116	2	19/09/92	01/05/99	2	24	1	0		7	0	0	7	7	0	0	7							9	9	0	9	9	0	0	9
117	1	17/10/92	01/05/99	1	6	2	0		7	7	0	7	7	1	1	7							9	9	0	9	9	0	0	9
118	2	23/01/93	01/05/99	2	18	2	0		7	5	9	7	7	3	3	7							9	0	0	9	9	0	0	9
119	2	25/01/92	01/05/99	2	72	2	0		7	0	0	7	7	1	1	7							9	0	9	0	9	0	2	9
121	2	13/06/91	01/05/99	2	12	2	0		7	0	0	7	7	1	1	7							0	0	0	0	0	0	0	0
122	1	24/06/92	01/05/99	2	6	2	0		7	0	0	7	7	0	0	7							9	0	0	9	9	0	0	9
123	1	20/09/89	01/05/99	1	24	1	0	01/04/85	7	12	8	7	7	12	12	7		0					9	0	0	9	9	2	2	9
124	2	22/09/93	01/05/99	1	36	2	0		7	7	7	7	7	0	0	7							9	9	9	9	9	0	0	9
125	2	07/08/91	01/05/99	2	12	2	0	01/02/98	7	0	8	7	7	8	8	7		1		1	0		9	0	0	9	9	3	0	9
126	1	17/09/91	01/05/99	2	24	2	1		7	0	0	7	7	0	0	7							0	0	0	0	0	0	0	0
127	1	08/01/92	01/05/99	2	12	2	0		7	0	0	7	7	0	0	7							9	0	0	9	0	0	0	9
128	1	26/07/93	01/05/99	2	24	2	0		7	7	7	7	7	0	0	7							9	9	9	9	9	0	0	9
129	2	02/06/93	01/05/99	2	6	2	4		7	7	7	7	7	0	0	7							0	0	0	0	0	0	0	0
130	1	28/10/93	01/05/99	1	36	2	0		7	0	0	7	7	0	0	7							9	0	0	9	9	0	0	9
131	2	26/03/93	01/05/99	2	12	1	7		7	0	7	7	7	0	0	7							9	0	9	9	9	0	0	9
132	1	03/07/93	01/05/99	2	12	2	0		7	7	7	7	7	0	0	7							9	9	9	9	9	0	2	9
136	1	01/04/91	01/05/99	2	27	2	0	01/10/98	7	8	1	7	7	8	8	7	1			0	0		9	0	0	9	9	0	0	9
138	1	29/04/93	01/05/99	2	30	2	0		7	0	0	7	7	0	0	7							9	0	9	9	9	0	0	9
142	2	01/06/88	01/05/99	1	72	2	7	01/07/98	7	8	2	7	7	0	0	7	0						9	0	0	9	0	0	0	0
143	2	16/11/92	01/05/99	2	12	2	0		7	2	2	7	7	10	10	7							9	0	0	9	9	0	0	9
144	1	16/12/87	01/05/99	2	12	2	0		7	2	2	7	7	2	0	7							9	0	0	0	9	0	0	0
145	2	12/09/87	01/05/99	2	12	2	0	01/08/97	7	8	8	7	7	8	10	0	1	1		1			9	0	0	0	0	0	0	0
146	1	03/07/87	01/05/99	2	30	2	1		0	4	1	0	0	1	1	0							0	2	2	0	3	0	2	3
147	1	07/12/86	01/05/99	2	12	1	0		7	4	0	7	0	0	0	0							9	0	0	9	0	0	0	0
148	2	11/10/87	01/05/99	1	18	2	0		0	1	1	0	0	1	1	0							0	0	0	0	0	0	0	0
149	2	24/04/93	01/05/99	2	12	1	0		7	7	0	7	7	10	0	7							9	9	0	9	9	0	0	9
150	1	04/06/93	01/05/99	1	12	2	0		7	7	7	7	7	0	0	7							9	9	9	9	9	0	0	9
151	2	14/04/87	01/05/99	2	12	1	0	01/09/97	9	1	8	9	0	8	8	2		1		1	1		0	0	0	9	0	0	0	0
153	1	31/01/87	01/05/99	2	24	2	0		1	3	1	0	3	1	1	4							0	0	0	0	0	0	0	0
154	1	19/10/87	01/05/99	2	6	2	0		7	0	1	7	9	1	0	9							9	0	0	9	0	0	0	0
155	2	25/02/87	01/05/99	2	24	2	1	01/04/98	7	8	8	7	7	8	2	7	0	0		0			9	0	0	9	9	0	0	9
156	2	17/05/87	01/05/99	2	24	2	0		7	0	0	7	0	1	0	0							0	0	0	0	0	0	0	0
157	1	18/07/89	01/05/99	2	48	2	1		7	2	2	7	7	12	4	7							9	0	0	9	0	0	0	0
158	1	18/07/89	01/05/99	2	48	2	1		7	1	1	7	7	1	12	7							9	0	0	9	9	0	0	9
159	1	24/03/88	01/05/99	2	24	2	0	01/05/97	7	8	8	7	7	8	8	7	0	0		0	0		9	0	0	9	0	0	0	0
160	1	04/01/87	01/05/99	1	36	2	0	01/06/97	2	6	8	0	0	6	6	2		1					9	9	0	0	0	9	9	0
162	2	11/08/91	01/06/99	2	24	1	0		7	0	0	7	7	0	0	7							9	0	0	9	0	0	0	9
163	1	17/12/93	01/06/99	2	24	2	4		7	7	7	7	7	0	0	7							9	9	9	9	9	0	0	9
164	1	26/03/88	01/06/99	2	6	2	0		7	0	1	7	7	0	0	7							9	0	0	9	0	0	0	0
165	2	04/07/87	01/06/99	1	24	2	4		7	0	0	7	0	0	1	0							0	0	0	0	0	0	0	0
166	2	12/06/99	01/06/99	1	36	2	0	01/09/96	2	8	10	1	0	6	8	0	2				1		0	2	0	0	0	9	0	0
167	1	04/08/87	01/06/99	2	39	2	4	01/02/97	7	8	8	2	3	6	8	3	1	0					9	0	0	0	0	9	9	0
168	1	07/06/87	01/06/99	2	24	1	0	01/09/95	7	8	8	7	7	6	6	7	1	0		1	1		9	0	0	9	0	0	0	0
169	1	08/04/87	01/06/99	2	36	2	0		2	0	1	1	2	0	0	2							0	0	0	0	0	0	0	0
170	1	06/07/86	01/06/99	2	48	2	0	01/03/95	0	0	1	0	12	8	8	0				0	0		0	0	0	0	0	0	0	0
171	2	30/09/87	01/06/99	2	53	1	0		7	0	0	7	0	0	0	7							9	0	0	9	0	0	0	0
172	1	01/09/93	01/06/99	2	36	2	0		7	7	7	7	7	0	0	7							9	9	9	9	9	0	0	9
174	1	19/02/93	01/06/99	2	24	2	0		7	0	0	7	7	0	0	7							9	0	0	9	9	0	0	9
176	2	13/09/93	01/06/99	2	36	2	0		7	7	0	7	7	0	0	7							9	9	0	9	9	0	0	9
177	2	19/02/93	01/06/99	2	24	2	0		7	0	0	7	7	0	0	7							9	0	2	9	9	0	0	9
178	2	23/06/87	01/06/99	2	18	2	0	01/04/96	0	8	10	1	0	8	8	0	1			0	0		0	0	0	0	0	0	0	0
179	2	03/08/87	01/06/99	2	18	2	2		7	0	0	7	7	0	0	7							9	0	0	9	9	0	0	9
180	2	13/10/87	01/06/99	2	30	1	0	01/04/82	7	8	8	7	7	8	8	2	0	0		0	0		0	0	0	9	0	0	0	0
181	2	20/10/87	01/06/99	2	12	2	0	01/10/98	0	0	0	0	8	8	0	8			0	1		0	0	0	0	9	0	0	0	0
182	1	17/01/87	01/06/99	2	18	2	0		0	0	0	0	0	0	0	0							0	0	0	0	0	0	0	0
183	2	08/05/87	01/06/99	1	24	2	0		7	0	0	7	7	0	0	7							2	2	9	0	0	0	0	0
184	1	08/05/87	01/06/99	2	24	2	0		0	2	2	5	2	6	1	1							0	0	0	2	0	9	0	0
185	2	23/09/86	01/06/99	2	24	2	0		7	2	2	7	2	1	1	0							0	0	2	0	2	0	0	0
187	2	18/03/88	01/06/99	2	24	2	0		7	6	8	7	5	7	7	5							9	9	9	9	3	9	9	4
188	1	20/04/91	01/06/99	2	36	2	0		7	0	0	7	7	0	0	7							9	0	0	9	9	0	0	9
189	1	22/01/89	01/06/99	2	72	1	1		7	10	10	7	7	10	0	7							9	0	0	9	0	0	0	0
190	2	21/11/88	01/06/99	2	12	2	0	01/05/97	7	1	1	7	7	5	8	7				0	0		9	0	2	0	0	0	0	0
191	1	30/12/87	01/06/99	2	18	2	0	01/04/97	7	8	8	7	7	8	8	7	1	1		1	1		9	0	0	9	0	2	2	0
192	1	29/06/89	01/06/99	2	24	2	0		0	0	0	0	0	0	0	0							0	0	0	0	0	0	0	0
193	2	17/12/87	01/06/99	2	18	1	0	01/05/96	7	2	1	7	0	5	8	0					0		9	0	0	9	0	4	2	0
194	2	24/09/87	01/06/99	2	24	2	0		7	0	0	7	7	0	0	7							0	0	0	0	0	0	0	0
196	2	20/07/87	01/06/99	2	48	1	0		2	1	1	0	12	1	1	12							0	0	0	0	9	0	0	0
197	1	04/04/93	01/06/99	2	12	2	1		7	7	0	7	7	0	0	7							9	0	0	9	9	0	0	9
198	1	28/01/87	01/06/99	2	12	1	1	01/07/96	0	8	5	0	0	8	8	0	1			1	1		0	0	2	0	0	0	0	0
199	1	03/12/88	01/06/99	2	36	2	0	01/06/94	7	8	4	7	0	1	5	0	0						9	0	0	9	0	0	3	0
201	1	23/02/93	01/06/99	2	18	2	0		7	0	0	7	7	0	0	7							9	0	0	9	9	0	0	9
202	2	09/01/92	01/06/99	2	12	2	0		7	0	10	7	7	0	10	7							9	0	0	9	9	0	0	9
203	2	27/06/89	01/06/99	1	24	2	0	01/06/98	7	1	8	7	7	1	2	7		0					9	0	0	9	0	2	0	0
204	1	18/11/86	01/06/99	2	36	2	0	01/04/98	7	1	1	7	7	4	8	7					0		9	0	0	9	9	0	0	9
205	2	15/05/87	01/06/99	1	24	2	0		2	2	2	2	2	2	2	2							0	0	0	0	0	0	0	0
206	1	09/06/87	01/06/99	2	12	2	1	01/06/97	0	8	6	0	0	6	0	0				0			0	9	9	0	0	0	2	0
208	2	21/08/89	01/06/99	1	64	2	0		7	0	1	7	7	0	0	7							9	0	0	9	0	0	0	0
209	1	28/12/90	01/06/99	2	65	2	0	01/07/97	7	8	8	7	7	1	1	7	0	0					9	0	0	9	9	0	0	9
210	2	03/03/91	01/06/99	1	18	2	4		7	0	0	7	7	0	0	7							9	0	0	9	9	0	0	9
212	2	24/02/91	01/06/99	2	12	2	1		7	0	0	7	7	0	0	7							9	0	0	9	0	0	0	0
213	1	26/05/91	01/06/99	2	48	2	0		7	1	1	7	7	1	1	7							9	0	0	9	9	0	0	9
214	1	24/08/92	01/06/99	2	9	2	0		7	0	0	7	7	0	0	7							9	0	0	9	9	0	0	9
215	2	14/01/92	01/06/99	2	36	2	4		7	0	0	7	7	0	12	7							9	0	0	9	9	2	0	9
216	2	01/02/91	01/06/99	2	12	2	0		7	0	0	7	7	0	0	7							9	0	0	9	9	0	0	9
217	2	25/12/90	01/06/99	2	24	2	0	01/11/97	7	8	8	7	7	0	0	7	0	0					9	0	0	9	9	0	0	9
218	2	24/06/92	01/06/99	2	9	2	4		7	0	0	7	7	0	0	7							9	0	0	9	9	0	0	9
219	2	12/01/87	01/06/99	2	24	2	0		0	1	1	1	3	5	1	1							0	0	0	0	0	2	0	0
220	1	07/03/90	01/06/99	2	12	2	0	01/09/98	7	8	8	7	7	8	8	7	0	0		0	0		9	0	0	9	9	0	0	9
223	1	10/10/87	01/06/99	2	36	2	0	01/05/98	7	8	8	0	0	8	8	0	1	1		0	0		0	0	0	0	0	0	0	0
224	1	04/11/88	01/06/99	2	24	2	0		7	4	1	7	7	2	1	7							9	2	0	9	9	0	0	9
225	1	20/07/87	01/06/99	2	48	1	8	01/03/95	0	8	8	0	8	8	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
226	1	13/10/87	01/06/99	2	24	1	0	01/06/96	0	6	0	0	0	0	8	0					0		0	9	0	0	0	0	0	0
227	1	13/02/91	01/06/99	1	12	2	0		7	1	1	7	7	1	1	7							0	0	0	0	0	0	0	0
228	2	04/02/93	01/06/99	2	26	1	0		7	0	0	7	7	0	0	7							9	0	9	9	9	0	0	9
229	1	03/07/87	01/06/99	2	36	2	0	01/05/96	7	8	8	7	7	8	5	7		1		12			9	9	9	9	9	0	2	9
231	1	30/9/88	01/06/99	2	12	2	1	01/07/97	7	6	6	7	9	6	6	9	0	0		1	1		0	0	0	0	0	2	2	0

233	1	26/12/93	01/06/99	2	36	2	1		7	7	0	7	7	0	12	7					0	0	0	0	0	0	0	0
234	2	02/02/93	01/06/99	2	12	2	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
235	1	19/03/89	01/06/99	2	24	2	0	01/08/97	7	8	6	7	7	8	6	7	0		0		0	0	0	0	0	0	0	0
236	2	18/03/89	01/06/99	2	12	2	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
237	1	01/02/87	01/06/99	2	24	2	0		1	1	1	1	1	1	1	1					0	0	0	0	0	0	0	0
239	2	26/12/88	01/06/99	2	28	2	0	01/06/98	2	8	8	2	2	8	8	2	1	0	0	0	0	0	0	0	0	0	0	0
240	1	25/10/92	01/06/99	2	24	2	0		0	0	0	0	6	10	10	0					0	0	0	0	0	0	0	0
241	1	23/03/92	01/06/99	2	9	2	0		7	1	1	7	7	1	1	7					0	0	0	0	0	0	0	0
242	1	30/11/92	01/06/99	1	54	2	0		7	7	0	7	7	4	1	7					0	0	0	0	0	0	0	0
243	2	27/12/88	01/06/99	1	15	2	7		0	1	1	0	12	1	1	0					0	0	0	0	2	0	0	0
244	1	07/12/89	01/06/99	1	10	1	0	01/06/98	7	8	0	7	7	8	8	7	1		0	1	0	0	0	0	0	0	0	0
245	2	16/04/92	01/06/99	2	6	2	0		7	10	0	7	7	0	0	7					0	0	0	0	0	0	0	0
246	2	17/02/88	01/06/99	2	12	2	0	01/12/96	7	8	8	7	7	8	6	7	0	0	0		0	0	0	0	0	0	0	0
247	1	21/12/92	01/06/99	2	24	2	0	01/08/98	7	6	8	7	7	8	6	7	0	0	0	0	0	0	0	0	0	0	0	0
249	2	02/12/88	01/06/99	2	18	2	0		7	1	1	7	7	1	1	7					0	0	0	0	0	0	0	0
250	1	07/05/91	01/06/99	1	24	1	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
252	1	23/11/91	01/06/99	2	12	1	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
253	1	09/09/91	01/06/99	2	36	2	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
254	1	14/06/92	01/06/99	2	12	2	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
255	1	28/05/92	01/06/99	2	18	2	1		7	0	5	7	7	5	5	7					0	0	2	0	0	2	3	0
256	2	21/06/92	01/06/99	1	12	2	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
257	2	16/02/91	01/06/99	2	24	2	0		7	1	1	7	7	1	1	7					0	0	0	0	0	0	0	0
258	2	03/02/92	01/06/99	1	36	2	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
259	2	22/0792	01/06/99	2	36	2	0		7	0	3	7	7	6	6	7					0	0	0	0	0	4	2	0
260	1	05/07/87	01/06/99	2	24	2	4		0	0	0	0	0	0	0	0					0	0	0	0	0	0	0	0
261	1	28/11/88	01/06/99	2	24	1	0		7	3	1	7	7	0	1	7					0	0	0	0	0	0	0	0
263	1	29/04/93	01/06/99	2	12	2	0		7	7	7	7	7	0	0	7					0	0	0	0	0	0	0	0
265	2	11/01/93	01/06/99	2	24	2	0		7	0	9	7	7	5	0	7					0	0	0	0	0	2	0	0
266	1	15/09/87	01/06/99	2	36	2	7		7	6	6	7	7	0	0	7					0	0	0	0	0	0	0	0
267	1	10/10/97	01/06/99	2	60	2	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
268	1	21/12/92	01/06/99	2	6	2	2	01/08/98	7	8	8	7	7	6	8	7	0	0	0	0	0	0	0	0	0	0	0	0
269	2	14/12/92	01/06/99	1	18	1/2/00	0	01/06/98	7	8	8	7	7	8	8	7	0	0	0	0	0	0	0	0	0	0	0	0
270	1	07/08/89	01/06/99	2	18	2	0		7	1	1	7	7	1	1	7					0	0	0	0	0	0	0	0
271	1	23/08/89	01/06/99	2	20	2	1		7	0	0	7	7	0	6	7					0	0	0	0	0	0	0	0
272	2	23/10/88	01/06/99	2	36	1	1	01/10/97	7	8	8	7	7	3	6	7	1	1		1	0	0	0	0	0	0	0	0
273	2	29/12/87	01/06/99	1	18	2	4	01/10/98	7	6	6	9	9	8	0	3	1	0	1	0	0	2	0	0	0	0	0	0
274	2	29/12/87	01/06/99	1	18	2	1		7	1	0	9	9	2	1	9					0	0	0	0	0	0	0	0
275	2	26/11/88	01/06/99	2	24	2	0	01/06/95	7	8	8	7	7	8	3	7	1	0	1		0	0	0	0	0	0	0	0
276	1	09/06/92	01/06/99	2	18	1	0		7	2	0	7	7	0	0	7					0	0	0	0	0	0	0	0
277	1	03/09/91	01/06/99	1	18	2	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
278	1	26/05/92	01/06/99	2	18	2	0		7	0	0	7	7	0	2	7					0	0	0	0	0	0	0	0
279	2	05/01/91	01/06/99	1	18	2	0	01/10/98	7	8	8	7	7	8	8	7	0	0	0	0	0	0	0	0	0	0	0	0
280	2	25/11/88	01/06/99	1	12	2	0	01/07/98	7	4	8	7	7	8	8	7		0	1	1	0	2	2	0	0	0	0	0
281	1	31/01/91	01/06/99	2	36	2	0		7	1	0	7	7	1	4	7					0	0	0	0	0	0	0	0
282	1	12/12/90	01/07/99	2	37	2	0	01/11/98	7	8	8	7	7	8	8	7	0	0	0	1	0	0	0	0	0	0	0	0
283	2	03/03/92	01/07/99	2	48	2	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
284	1	01/02/87	01/07/99	2	48	2	0		0	0	0	0	0	0	0	0					0	0	0	0	0	0	0	0
285	2	13/06/93	01/07/99	2	24	2	1		7	7	9	7	7	0	0	7					0	0	0	0	0	0	0	0
286	1	13/05/93	01/07/99	2	12	2	0	01/12/98	7	0	8	7	7	3	8	7		1		1	0	0	0	0	0	0	0	0
287	2	04/02/93	01/07/99	2	36	2	0		7	2	2	7	7	4	4	7					0	0	0	0	0	0	0	0
288	1	09/03/89	01/07/99	2	18	2	0		7	1	0	7	7	0	0	7					0	0	0	0	0	0	0	0
289	1	02/06/89	01/07/99	1	12	2	0		7	2	0	7	7	0	0	7					0	0	0	0	0	0	0	0
290	1	23/02/89	01/07/99	2	8	1	1		7	10	10	7	7	10	0	7					0	0	0	0	0	0	0	0
291	1	19/01/89	01/07/99	1	12	2	0		7	5	0	7	7	10	0	7					0	0	0	0	0	0	0	0
292	1	25/08/89	01/07/99	2	12	2	7	01/02/97	7	2	8	7	7	0	1	7		0			0	0	0	0	0	0	0	0
293	1	14/09/89	01/07/99	2	18	1	0		7	10	10	7	7	0	0	7					0	0	0	0	0	0	0	0
294	1	18/09/89	01/07/99	2	24	2	1		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
295	1	17/07/89	01/07/99	1	24	2	7	01/08/97	7	6	8	7	7	0	0	7		1			0	0	0	0	0	0	0	0
296	1	24/02/89	01/07/99	1	18	2	8	01/03/97	7	8	1	7	7	8	8	7	0		0	1	0	0	0	0	0	0	0	0
299	1	06/04/89	01/07/99	2	24	2	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
300	1	12/05/89	01/07/99	2	60	2	0		7	1	1	7	7	1	4	7					0	0	0	0	0	0	0	0
301	1	18/05/89	01/07/99	2	12	1	0		7	2	0	7	7	0	0	7					0	0	0	0	0	0	0	0
302	1	15/04/89	01/07/99	2	36	1	4	01/08/96	7	8	8	7	7	8	8	7	0	0	0	0	0	0	0	0	0	0	0	0
303	1	27/10/89	01/07/99	2	36	1	6	01/04/89	7	8	0	7	7	8	8	7	0		0	0	0	0	0	0	0	0	0	0
304	2	18/09/87	01/07/99	2	12	2	0	01/09/95	0	6	6	2	1	6	6	1		0	1		0	0	0	0	0	0	0	0
305	1	27/10/92	01/07/99	2	60	2	0		7	0	7	7	7	0	0	7					0	0	0	0	0	0	0	0
306	2	16/04/92	01/07/99	2	6	2	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
307	2	10/05/88	01/07/99	2	12	2	0	01/06/98	7	8	8	7	9	8	8	8	1	1	1	1	0	0	0	0	0	0	0	0
308	1	12/02/93	01/07/99	1	24	2	0		7	2	2	7	7	9	0	7					0	0	0	0	0	0	0	0
309	2	23/11/93	01/07/99	2	18	2	0		7	7	7	7	7	0	0	7					0	0	0	0	0	0	0	0
310	2	28/06/90	01/07/99	2	24	2	0	01/04/98	7	8	6	7	7	8	8	7	0	0	0	0	0	0	0	0	0	2	0	0
311	2	26/04/93	01/07/99	2	36	2	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
312	2	31/01/87	01/07/99	2	24	2	1		7	0	0	7	9	8	6	4					0	0	0	0	0	0	0	2
313	2	03/08/90	01/07/99	2	12	2	1		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
314	1	08/12/92	01/07/99	2	12	2	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
315	2	10/05/88	01/07/99	2	12	2	0	01/09/98	7	8	8	7	0	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0
316	1	01/06/91	01/07/99	2	18	2	1		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
317	1	21/11/90	01/07/99	1	24	2	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
318	1	17/07/89	01/06/99	1	12	2	1		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
319	2	16/08/92	01/06/99	2	24	2	0		7	10	10	7	7	0	0	7					0	0	0	0	0	0	0	0
320	1	16/02/87	01/06/99	2	6	2	0		9	0	0	9	9	0	0	9					0	0	0	0	0	0	0	0
321	1	03/01/93	01/06/99	1	24	1	0		7	0	9	7	7	0	0	7					0	0	0	0	0	0	0	0
322	1	16/06/92	01/06/99	2	6	2	1		7	7	7	7	7	0	0	7					0	0	0	0	0	0	0	0
323	2	07/07/86	01/06/99	1	12	2	0	01/06/98	7	8	8	7	7	4	8	7	0	0		0	0	0	0	0	0	0	0	0
324	2	12/10/92	01/06/99	2	18	2	2	01/01/98	7	8	8	7	7	8	8	7	0	0	0	0	0	0	0	0	0	0	0	0
325	2	13/11/92	01/06/99	2	24	2	0		7	0	0	7	7	0	0	7					0	0	0	0	0	2	0	0
326	2	08/06/92	01/06/99	2	24	2	0		7	0	0	7	7	10	0	7					0	0	0	0	0	2	0	0
327	1	06/02/92	01/06/99	2	12	2	1		7	0	2	7	7	5	2	7					0	0	0	0	0	3	0	0
328	2	21/04/88	01/06/99	1	24	1	0	01/07/97	7	8	8	7	4	8	8	4	0	0	0	0	0	0	0	0	0	0	0	0
329	1	22/11/92	01/06/99	1	24	2	0		7	2	2	7	7	0	0	7					0	0	0	0	0	0	0	0
330	1	19/05/88	01/06/99	2	24	2	0	01/02/98	7	8	1	7	7	0	0	7	1				0	0	0	0	0	0	0	0
331	1	21/11/89	01/06/99	2	36	2	0		7	0	0	7	7	0	0	7					0	0	0	0	0	0	0	0
332	1	22/12/88	01/06/99	2	24	2	0		7	0	8	7	7	1	8	7					0	0	0	0	0	0	0	0
333	1	12/01/89	01/06/99	1	24	2	0	01/06/98	7	8	8	7	7	8	8	7	0	0	0	2	0	0	0	0	0	0	2	0
334	2	04/10/88	01/06/99	2	24	2	1		7	1	0	7	7	2	0	7					0	2	0	0	0	0	0	0
335	2	01/11/88	01/06/99	1	13	2	1	01/10/97	7	8	8	7	7	0	0	7	1	1			0	0	0	0	0	0	0	0
336	2	31/07/88	01/06/99	1	18	2	0	01/10/95	7	8	8	7	9	8	8	0		0	0	0	0	0	0	0	0	0	0	0
337	1	01/04/88	01/06/99	2	12	2	1	01/11/98	7	8	6	7	7	8	8	7	0	1	1	1	0	0	0	0	0	0	0	0

338	1	26/02/88	01/08/99	2	6	2	0		9	0	1	1	4	0	0	4						0	0	0	0	0	0	0	3
339	2	05/05/88	01/08/99	2	10	2	0		2	0	0	2	0	0	0	0						0	0	0	0	0	0	0	0
340	1	23/12/88	01/08/99	2	24	2	0	01/08/98	7	0	0	7	9	8	8	7			1	0		9	0	0	0	9	0	0	0
341	2	28/03/88	01/08/99	2	17	1	0		7	0	0	7	7	0	0	7						9	0	2	9	9	2	0	0
343	2	13/01/92	01/08/99	2	12	2	1		7	0	0	7	7	0	1	7						9	0	0	9	9	0	0	9
344	1	14/09/92	01/08/99	2	12	2	1		7	2	2	7	7	0	0	7						9	0	0	9	9	0	0	9
345	2	12/03/92	01/08/99	2	12	2	0	01/12/98	7	8	8	7	7	8	8	7	1	1	1	0		9	0	0	9	9	0	0	9
346	1	03/12/92	01/08/99	2	38	2	0		7	2	2	7	7	9	0	7						0	0	0	0	0	0	0	0
347	2	13/07/92	01/08/99	2	12	2	1		7	0	1	7	7	1	0	7						9	0	0	9	0	9	0	0
348	1	13/01/92	01/08/99	1	18	2	0		7	0	0	7	7	0	0	7						9	0	0	9	9	0	0	9
349	1	18/05/91	01/08/99	2	24	2	7		7	3	1	7	7	0	0	7						9	0	0	9	9	0	0	9
350	1	01/08/92	01/08/99	2	24	2	0		7	2	0	7	7	0	0	7						9	0	0	9	9	0	0	9
351	2	18/10/88	01/08/99	2	24	2	0		7	0	0	7	7	0	1	7						9	0	0	9	0	0	0	0
352	1	28/11/91	01/08/99	1	12	2	0		7	0	0	7	7	0	0	7						9	0	0	9	9	0	0	9
353	2	13/01/88	01/08/99	2	12	2	4	01/01/98	3	8	0	9	1	0	0	0	1					0	0	0	0	0	0	0	0
355	1	19/09/89	01/08/99	2	24	1	1		7	0	0	7	7	3	0	7						9	0	0	9	9	0	0	9
356	1	13/10/89	01/08/99	1	4	2	0		7	0	0	7	7	0	0	7						9	0	0	9	9	0	0	9
357	2	23/05/88	01/08/99	2	6	2	7		7	0	0	7	7	0	0	7						9	0	0	9	0	0	0	0
358	2	27/04/89	01/08/99	2	12				7	0	0	7	7	0	0	7						9	2	0	9	9	0	0	9
359	1	01/02/89	01/08/99	2	12	1	0	01/06/95	7	8	8	7	7	8	8	7	0	1	0	1		9	0	2	9	9	0	2	0
360	2	22/11/89	01/08/99	2	17	2	0		7	0	0	7	7	1	1	7						9	0	0	9	9	0	0	9
361	1	21/03/88	01/08/99	2	12	2	0	01/11/98	7	8	8	7	7	8	8	7	1	1		1		9	0	0	9	0	9	0	9
362	1	11/08/88	01/08/99	2	14	2	0		7	0	0	7	7	0	0	7						9	0	0	9	0	0	0	0
363	1	20/01/89	01/08/99	2	18	1	0		7	1	1	7	0	0	1	0						9	0	0	9	0	0	0	0
364	1	21/11/90	01/08/99	2	22	1	0	01/04/98	7	4	8	7	7	8	8	7		1	1	1		9	0	0	9	0	0	0	0
365	2	05/10/88	01/08/99	2	11	2	7	01/11/94	7	8	8	7	0	8	8	0	0	0	0			0	0	0	0	0	0	9	0
366	1	27/03/87	01/08/99	2	12	2	4	01/12/95	0	8	8	7	7	0	8	7	0	0		0		0	0	0	9	0	0	0	0
367	1	21/12/88	01/08/99	2	36	2	0	01/12/97	7	8	8	7	7	8	8	7	0	12	1	1		0	0	2	0	0	0	0	0
368	2	07/01/87	01/08/99	2	8	2	4		0	1	1	0	0	0	1	0						0	0	0	0	9	0	0	9
369	2	13/04/88	01/08/99	2	12	2	4	01/10/96	7	1	1	7	7	4	8	7				0		9	0	0	9	9	2	0	9
370	2	22/04/92	01/08/99	2	24	2	0		7	0	0	7	7	0	0	7						9	0	0	9	0	0	0	0
371	1	17/09/92	01/08/99	1	18	2	0		7	0	0	7	7	0	0	7						0	0	0	0	9	0	0	9
372	2	29/04/89	01/08/99	2	12	2	0		7	0	0	7	7	0	8	7						9	0	0	9	0	0	9	0
373	1	01/09/89	01/08/99	2	12	1	1	01/04/98	7	0	0	7	7	8	8	7			0	0		0	0	0	0	9	0	0	9
374	1	13/02/89	01/08/99	2	12	2	0		7	2	3	7	7	0	0	7						9	0	2	9	0	2	9	0
375	1	09/03/95	01/08/99	2	12	2	1		7	0	1	7	7	0	0	7						9	0	0	9	9	0	0	0
376	2	20/05/89	01/08/99	2	12	2	1	01/04/97	7	8	8	7	7	8	8	7	0	0	1	1		9	0	0	9	9	0	0	9
377	1	29/08/89	01/08/99	2	12	2	0	01/06/98	7	1	8	7	7	8	8	7		1	0	0		9	0	0	9	9	0	0	9
378	1	21/02/89	01/08/99	1	15	2	0	01/05/98	7	8	8	7	7	0	8	7	0	1		1		9	0	0	9	0	0	0	0
379	1	02/08/89	01/08/99	1	12	2	0		7	0	0	7	7	0	0	7						9	0	0	9	9	0	9	9
380	2	02/11/89	01/08/99	2	72	2	0	01/10/98	7	0	1	7	7	8	8	7			1	1		9	0	0	9	9	0	0	9
381	1	15/05/92	01/08/99	1	18	2	0		7	9	0	7	7	0	0	7						9	0	0	9	9	0	0	9
382	2	10/12/89	01/08/99	2	45	2	0	01/12/98	7	8	1	7	9	8	8	9	0		2	0		9	9	0	9	9	0	0	9
383	2	31/1/89	01/08/99	2	24	1	1	01/04/97	7	3	8	7	7	1	8	7		1		1		9	0	0	9	9	3	0	9
384	2	28/09/90	01/08/99	2	24	2	1	01/08/98	7	0	0	7	7	8	8	7			0	0		9	0	0	9	9	0	0	9
385	1	09/04/91	01/08/99	2	12	2	0	01/09/97	7	8	8	7	7	8	6	7	0	0	1			9	0	0	9	0	0	0	0
386	1	01/08/91	01/08/99	2	12	2	0		7	1	1	7	7	1	1	7						9	0	0	9	0	0	9	0
387	1	11/10/91	01/08/99	1	24	2	4		7	0	0	7	7	0	0	7						9	0	0	9	9	0	0	9
388	1	11/02/91	01/08/99	2	18	2	0	01/03/98	7	8	8	7	7	8	8	7	0	0	0	0		9	0	0	9	9	0	0	9
389	2	13/03/91	01/08/99	2	24	2	0	01/09/98	7	8	8	7	7	8	8	7	1	1	2	2		9	2	0	9	9	2	2	9
390	1	31/07/91	01/08/99	1	6	2	0	01/07/98	7	8	8	7	7	8	8	7	1	0	0	1		9	0	0	9	0	2	2	9
391	2	11/07/91	01/08/99	2	7	2	0		7	0	0	7	7	0	0	7						9	0	0	9	9	0	0	9
392	1	06/10/93	01/08/99	1	12	2	0		7	7	7	7	7	0	0	7						9	0	0	9	9	0	0	9
393	1	05/06/93	01/08/99	2	18	2	0		7	7	9	7	7	0	0	7						9	0	0	9	9	0	0	9
394	1	18/05/93	01/08/99	1	9	2	0		7	7	7	7	7	0	0	7						9	9	9	9	9	0	0	9
395	1	27/04/91	01/09/99	2	24	1	0	01/08/98	7	8	8	7	7	8	8	7	1	1	1	1		9	9	9	9	9	0	0	9
396	2	12/09/91	01/09/99	1	12	2	4		7	2	2	7	7	2	2	7						9	2	0	9	9	0	0	9
397	1	16/08/91	01/09/99	2	9	2	1		7	10	10	7	7	0	0	7						9	0	0	9	9	0	0	9
398	1	10/10/91	01/09/99	2	24	1	4		7	0	0	7	7	0	0	7						9	9	0	9	0	0	0	9
399	2	26/07/91	01/09/99	2	8	2	6		7	2	0	7	7	0	0	7						9	0	0	9	9	0	0	9
400	1	12/03/91	01/09/99	2	24	2	0	01/03/99	7	8	0	7	7	8	0	7	0		1			9	2	0	9	0	0	0	0
401	2	31/08/93	01/09/99	1	24	2	0		7	0	0	7	7	0	0	7						9	2	0	9	9	0	0	9
402	1	09/06/93	01/09/99	2	24	2	0		7	0	7	7	7	0	0	7						9	0	0	9	9	0	0	9
403	1	29/03/91	01/09/99	2	12	2	0		7	2	3	7	7	9	0	7						9	0	0	9	9	0	0	9
404	2	01/03/94	01/09/99	2	36	2	7		7	0	0	7	7	0	0	7						9	0	0	9	9	0	0	9
405	2	13/05/93	01/09/99	2	12	2	0		7	0	0	7	7	0	0	7						9	0	0	9	9	0	0	9
406	2	13/05/93	01/09/99	2	30	2	7		7	2	0	7	7	0	0	7						9	0	0	9	9	0	0	9
407	1	03/05/93	01/09/99	2	38	1	0		7	7	0	7	7	0	0	7						9	9	0	9	9	0	0	9
408	2	03/06/93	01/09/99	2	12	1	0		7	0	0	7	7	0	0	7						9	0	0	9	9	0	0	9
409	1	11/06/93	01/09/99	2	9	2	0		7	7	7	7	7	0	0	7						9	0	0	9	9	0	0	9
410	2	09/11/93	01/09/99	2	12	2	0		7	7	7	7	7	0	0	7						9	0	0	9	9	0	0	9
411	1	08/09/90	01/09/99	2	18	2	0		7	2	0	7	7	0	6	7						9	0	0	9	9	0	2	9
412	2	08/04/92	01/09/99	2	24	1	0		7	0	0	7	7	0	0	7						9	0	0	9	9	0	0	9
413	1	11/03/88	01/09/99	2	30	2	2	01/03/98	1	8	8	1	1	8	8	1	1	0				0	0	0	0	0	9	9	9
414	1	10/09/88	01/09/99	1	11		1		7	1	5	7	7	1	5	7						0	0	2	0	0	0	3	0
415	1	01/07/87	01/09/99	1	6	2	0		7	0	0	7	7	0	0	7						9	0	0	9	0	0	0	0
416	1	17/04/93	01/09/99	1	20	2	0	01/03/98	7	8	8	7	7	5	8	7	0	0		0		9	2	3	9	9	3	0	9
417	1	04/04/91	01/09/99	2	24	2	0		7	0	2	7	7	3	0	7						9	0	0	9	9	0	0	9
418	1	11/12/90	01/09/99	2	6	2	0	01/02/98	7	0	0	7	7	8	8	7			1	1		9	0	0	9	9	0	0	9
419	1	18/10/89	01/09/99	1	48	2	1		7	0	0	7	0	0	4	7						9	0	0	9	0	0	2	9
420	1	19/06/91	01/09/99	2	12	2	1		7	0	0	7	7	0	0	7						9	0	0	9	9	0	0	9
421	1	27/07/91	01/09/99	2	48	2	2		7	0	0	7	7	0	0	7						9	0	0	9	0	0	0	0
422	2	12/11/88	01/09/99	1	24	2	0		7	6	6	7	7	6	5	0						9	9	9	9	0	9	2	0
423	2	01/11/88	01/09/99	1	13	2	0	01/08/98	7	8	8	7	7	0	0	7	1	1				9	0	0	9	9	0	0	9
424	2	19/2/93	01/09/99	1	12	2	7		7	9	7	7	7	0	0	7						9	0	0	9	9	0	0	9
425	2	12/11/90	01/09/99	2	11	2	0	01/08/98	7	8	0	7	7	0	0	7	0					9	0	0	9	9	0	0	9
426	2	25/05/91	01/10/99	2	12	2	0	01/10/97	7	8	8	7	7	6	8	7	0	0	1	1		9	0	0	9	9	0	0	9
427	2	17/07/93	01/10/99	2	12	2	0		7	0	0	7	7	0	0	7						9	0	0	9	9	0	0	9
428	1	14/01/87	01/10/99	2	72	2	4	01/06/98	3	6	8	3	8	6	8	8		1			1	0	9	0	0	9	9	9	2
429	2	08/05/88	01/10/99	2	12	1	0	01/05/97	2	6	3	9	4	6	8	3			1	1		0	9	0	0	2	0	0	0
430	2	03/07/88	01/10/99	2	30	2	0		2	0	0	9	9	0	0	0						0	0	0	0	0	0	0	0
431	1	04/01/93	01/10/99	2	24	1	0		7	0	0	7	7	0	0	7						9	0	0	9	9	0	0	9
432	2	21/09/87	01/10/99	2	36	2	0	01/12/95	2	8	3	0	0	8	8	0	1		0	1		0	2	0	0	0	2	2	0
433	2	27/07/87	01/10/99	2	24	2	4		7	3	1	0	9	0	0	7						0	0	0	0	0	0	0	0
434	2	03/10/87	01/10/99	2	36	2	4		0	4	4	0	0	5	4	0						0	2	0	0	0	2	2	0
435	1	23/03/87	01/10/99	1	18	2	0	01/08/95	0	6	8	0	7	1	8	7		1		1		0	9	0	0	0	0	2	9
436	2	29/10/89	01/10/99	2	9	1	0	01/04/98	7	8	8	7	7	0	0	7	1	0				9	0	0	9	9	0	0	9
437	2	14/02/91	01/10/99	2	12	2	0	01/04/98	7	8	8	7	7	8	8	7	0	0	0	0		9	0	0	9	9	0	0	9

438	1	26/04/91	01/10/99	2	24	2	0	01/09/98	7	8	8	7	7	8	8	7						
439	1	18/08/91	01/10/99	1	9	2	0		7	0	0	7	7	0	0	7	0	0		0	0	
440	2	09/03/91	01/10/99	1	18	2	0	01/09/98	7	0	0	7	7	8	12	7						
441	1	27/05/88	01/10/99	1	12	2	0	01/08/97	1	8	8	0	8	8	8	8				0		
442	2	22/07/87	01/10/99	2	24	2	0		0	0	0	0	0	0	8	0	0	0	0	0	0	0
443	1	22/04/88	01/10/99	2	12	1	0	01/07/96	0	8	5	0	0	8	3	0						
444	2	03/06/91	01/10/99	2	72	2	0		7	1	1	7	7	5	1	7	0	1		1		
445	2	21/07/92	01/10/99	2	36	2	0		7	0	0	7	7	0	0	7						
446	2	01/09/93	01/10/99	2	24	2	0		7	1	0	7	7	0	0	7						
447	1	11/10/90	01/10/99	1	6	2	0		7	0	0	7	7	0	0	7						
448	1	25/03/93	01/10/99	2	14	2	0	01/05/98	7	8	1	7	7	1	1	7						
449	1	12/09/89	01/10/99	2	12	2	0	01/06/97	7	0	0	7	7	8	0	7	1					
450	2	27/06/91	01/10/99	1	24	2	1		7	0	0	7	7	0	0	7						
451	1	12/07/90	01/10/99	2	12	2	0		7	0	0	7	7	0	0	7				0	0	
4521	1	25/02/92	01/01/00	2	12	2	0		7	0	0	7	7	0	0	7						
4522	1	18/05/90	01/02/00	2	36	2	1		7	0	0	7	7	0	0	7						
453	1	15/06/90	01/02/00	1	18	1	0	01/02/98	7	8	8	7	7	4	0	7						
454	1	13/06/94	01/02/00	1	12	2	0		7	0	0	7	7	1	1	7	0	1				
455	2	28/05/92	01/02/00	2	12	1	1		7	0	0	7	7	0	0	7						
456	2	17/1/92	01/02/00	2	24	2	0		7	2	0	7	7	0	0	7						
457	1	29/4/92	01/02/00	2	18	2	0		7	0	0	7	7	0	0	7						
458	2	20/5/92	01/02/00	2	12	2	0		7	7	7	7	7	0	1	7						
459	1	07/01/92	01/02/00	2	18	2	4		7	0	0	7	7	0	0	7						
460	1	30/6/92	01/02/00	1	12	2	1		7	0	0	7	7	0	2	7						
461	2	25/3/92	01/02/00	2	12	2	1		7	2	0	7	7	2	2	7						
462	1	15/11/90	01/02/00	2	24	2	0	01/12/98	7	8	8	7	7	8	8	7						
463	1	23/3/91	01/02/00	2	42	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	1		1	1	
464	2	26/6/91	01/02/00	2	24	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
465	2	24/1/91	01/02/00	2	18	2	0	01/07/98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
466	1	12/07/90	01/02/00	1	24	2	2	01/10/98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	0		1	0	
467	2	28/3/89	01/02/00	2	24	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0		0	1	
468	2	25/10/90	01/02/00	2	18	2	0	01/02/97	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
469	1	23/5/91	01/02/00	2	12	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0		0	1	
470	1	04/11/90	01/02/00	1	18	2	0	01/06/98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
471	2	18/1/90	01/02/00	2	12	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		1				
472	1	30/1/90	01/02/00	1	18	2	1		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
473	2	29/11/91	01/02/00	2	12	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
474	2	23/11/91	01/02/00	2	30	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
475	1	18/12/91	01/02/00	2	12	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
476	1	11/06/93	01/02/00	2	12	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
477	2	17/5/92	01/02/00	2	12	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
478	1	23/9/92	01/02/00	2	38	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
479	1	17/10/92	01/02/00	2	30	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
480	1	23/9/91	01/02/00	2	24	2	0	01/02/98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
481	1	26/5/90	01/02/00	1	30	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1					
482	1	22/6/92	01/02/00	1	12	1	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
483	2	24/7/93	01/02/00	2	12	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
484	1	04/11/90	01/02/00	1	12	1	0	01/07/98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
485	2	26/8/88	01/02/00	2	18	2	0	01/05/95	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0					
486	1	22/4/88	01/02/00	2	18	2	7	01/08/97	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0			0	0	
487	1	23/9/91	01/02/00	2	40	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0		1	1	
488	1	16/5/87	01/02/00	1	40	1	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
489	2	28/8/91	01/02/00	2	24	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
490	1	12/04/88	01/02/00	1	18	2	1		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
491	2	13/8/88	01/02/00	2	6	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
492	1	23/5/91	01/02/00	2	24	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
493	2	31/8/88	01/02/00	2	24	2	0	01/07/96	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
494	1	08/04/89	01/02/00	2	6	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	1			1	
495	1	06/04/90	01/02/00	2	8	2	0	01/10/98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
496	1	13/7/89	01/02/00	2	12	2	1		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1			0	1	
497	2	18/10/89	01/02/00	2	24	2	0	01/07/97	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
498	1	18/06/92	01/02/00	2	30	1	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	0		1		
499	1	18/5/92	01/02/00	1	24	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
500	2	19/8/91	01/02/00	1	12	2	0	01/06/98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
501	2	02/07/93	01/02/00	1	18	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0				
502	1	02/07/91	01/02/00	2	36	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
503	2	07/02/92	01/03/00	2	24	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
504	2	26/10/91	01/03/00	2	12	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
505	1	02/09/92	01/03/00	2	64	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
506	2	10/11/92	01/03/00	2	36	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
507	2	16/1/93	01/03/00	2	17	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
508	2	20/02/93	01/03/00	2	18	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
509	1	22/08/89	01/03/00	1	38	2	0	01/05/95	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
510	2	20/03/93	01/03/00	2	18	2	1	01/10/98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
511	2	03/12/88	01/03/00	2	24	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				1	1	
512	2	15/03/89	01/03/00	2	18	2	0	01/05/98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				12	1	
513	1	08/02/89	01/03/00	2	18	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
514	1	18/10/89	01/03/00	2	24	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				1	1	
515	1	22/06/89	01/03/00	2	24	1	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
516	2	04/08/88	01/03/00	2	24	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
517	2	26/8/89	01/03/00	2	24	2	0	01/04/98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
518	1	27/4/89	01/03/00	2	18	2	0	01/10/95	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	1		1	1	
519	2	25/4/89	01/03/00	2	24	1	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0			1		
520	1	23/11/90	01/03/00	1	24	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
521	1	18/9/91	01/03/00	1	12	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
522	1	18/10/91	01/03/00	2	24	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
523	1	08/01/90	01/03/00	2	10	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
524	2	12/07/91	01/03/00	2	12	1	1		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
525	1	07/03/91	01/03/00	2	18	2	0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
526	2	25/10/90	01/03/00	2	36	2	0	01/04/99	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		1		1	0	